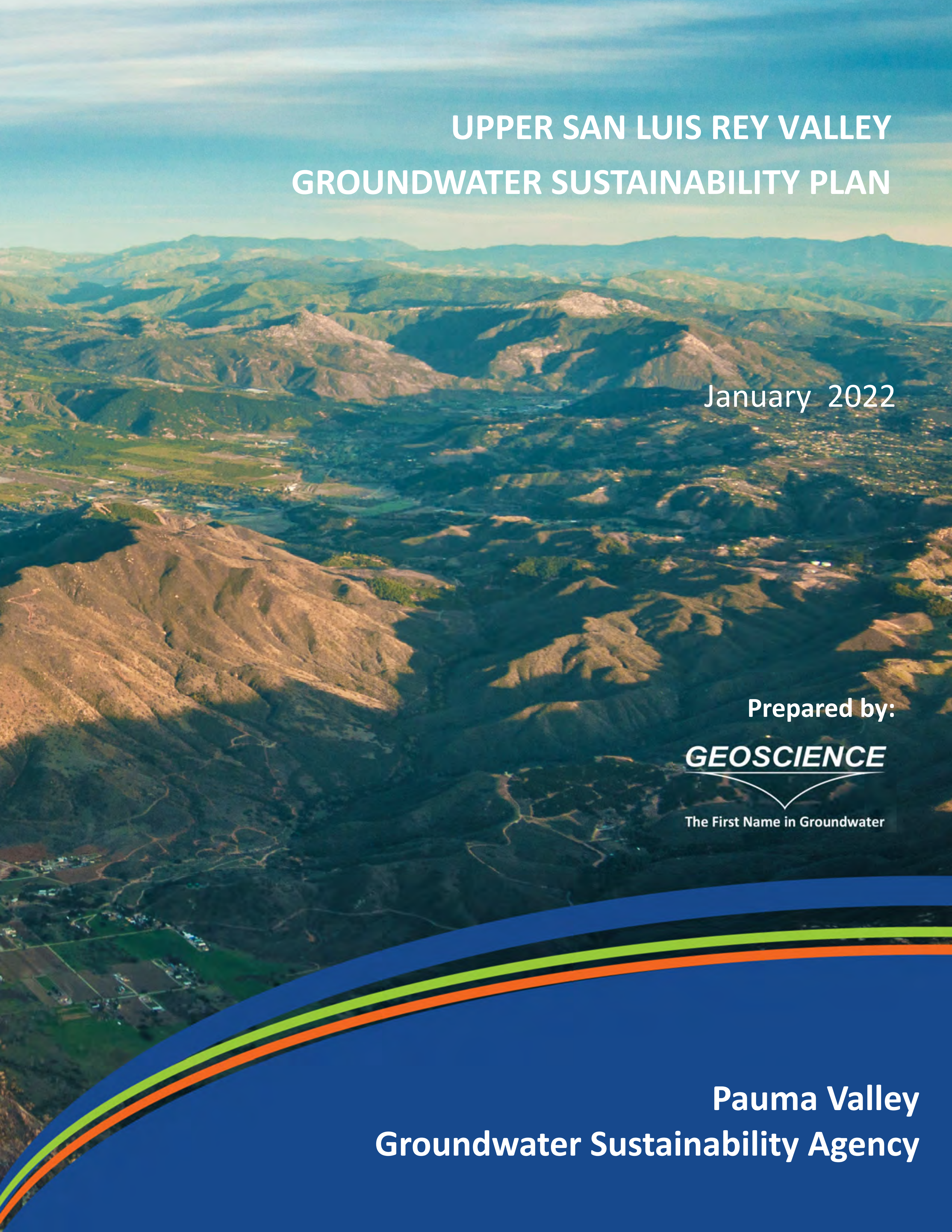

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

January 2022

Prepared by:

GEOSCIENCE

The First Name in Groundwater

Pauma Valley Groundwater Sustainability Agency

THIS REPORT IS RENDERED TO PAUMA VALLEY GROUNDWATER SUSTAINABILITY AGENCY AS OF THE DATE HEREOF, SOLELY FOR THEIR BENEFIT IN CONNECTION WITH ITS STATED PURPOSE AND MAY NOT BE RELIED ON BY ANY OTHER PERSON OR ENTITY OR BY THEM IN ANY OTHER CONTEXT. ALL CALCULATIONS WERE PERFORMED USING ACCEPTED PROFESSIONAL STANDARDS.

AS DATA IS UPDATED FROM TIME TO TIME, ANY RELIANCE ON THIS REPORT AT A FUTURE DATE SHOULD TAKE INTO ACCOUNT UPDATED DATA.

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UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

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1a	GSP Checklist
2a	San Luis Rey Valley Groundwater Basin Groundwater Sustainability Plan Public

Acronyms, Abbreviations, and Initialisms

Abbrev.	Description
acre-ft/yr	acre-feet per year
amsl	above mean sea level
ASR	Aquifer Storage and Recovery
CASGEM	California Statewide Groundwater Elevation Monitoring Program
CCR	California Code of Regulations
CCTAG	Climate Change Technical Advisory Group
CDPH	California Department of Public Health
CEQA	California Environmental Quality Act
CIMIS	California Irrigation Management Information System
CSD	Community Services District
DAC	Disadvantaged Community
DDW	California Division of Drinking Water
DEH	Department of Environmental Health
DI	deionized
DO	dissolved oxygen
DTSC	California Department of Toxic Substances Control
DWR	California Department of Water Resources
EB	equipment blank
ELD	Enhanced Leak Detection
EPA	United States Environmental Protection Agency (also USEPA)
EWMP	Efficient Water Management Practice
eWRIMS	Electronic Water Rights Information Management System
ft	feet
FRWR	Federal Reserved Water Right

gal/ft	gallons per foot
GAMA	Groundwater Ambient Monitoring and Assessment program
GDE	Groundwater Dependent Ecosystem
Geoscience	Geoscience Support Services, Inc.
GIS	Geographic Information System
GSA	Groundwater Sustainability Agency
GSP	Groundwater Sustainability Plan
HSPF	Hydrologic Simulation Program - Fortran
IDA	Improvement District "A"
IID	Imperial Irrigation District
IM	Interim Milestone
IRWM	Integrated Regional Water Management
ISW	Interconnected Surface Water
JPA	Joint Powers Agreement
LAFCO	San Diego Local Agency Formation Commission
LAR	Land Area Representation
meq/L	milliequivalents per liter
Metropolitan	Metropolitan Water District of Southern California
µg/L	micrograms per liter
mg/L	milligrams per liter
mL	milliliter
MO	Management Objective
MT	Minimum Threshold
mV	millivolts
MWC	Mutual Water Company
MWD	Municipal Water District
NOAA	National Oceanic and Atmospheric Administration
NRCS	National Resources Conservation Service

NTU	nephelometric turbidity units
NWCC	National Water and Climate Center
NWIS	National Water Information System
ORP	redox potential
Pauma MWD	Pauma Municipal Water District
PHG	Public Health Goal
PPE	personal protective equipment
PRISM	Parameter-elevation Regression on Independent Slopes Model
PUD	Public Utilities District
PVGSA	Pauma Valley Groundwater Sustainability Agency
QA/QC	quality assurance and quality control
RAC	Regional Advisory Committee
RAWMP	Regional Agricultural Water Management Plan
RCD	Upper San Luis Rey Resource Conservation District
Regional Board	San Diego County Regional Water Quality Control Board
RMS	Representative Monitoring Site
RP	reference point
RWMG	Regional Water Management Group
SANDAG	San Diego Association of Governments
SanGIS	San Diego Regional GIS Data Source
SAP	Sampling and Analysis Plan
SCS	SCS Engineers
SDAC	Severely Disadvantaged Community
SDCFB	San Diego County Farm Bureau
SDWIS	Safe Drinking Water Information System
SEC	Specific electrical conductance
SLRIWA	San Luis Rey Indian Water Authority
SLRMWD	San Luis Rey Municipal Water District

SGMA	Sustainable Groundwater Management Act
SMC	Sustainable Management Criteria
SWM	Stanford Watershed Model
SWP	State Water Project
SWRCB	State Water Resources Control Board
TAF	thousand acre-feet
TDS	total dissolved solids
TSAWR	Transitional Special Agricultural Water Rate
UR	Undesirable result
USEPA	United States Environmental Protection Agency (also EPA)
USGS	United States Geological Survey
USLR	Upper San Luis Rey
USLRGM	Upper San Luis Rey Groundwater Model
USLRRCD	Upper San Luis Rey Resource Conservation District
UWMP	Urban Water Management Plan
VIC	Variable Infiltration Capacity
VID	Vista Irrigation District
VOC	volatile organic compound
Water Authority	San Diego County Water Authority
WQIP	Water Quality Improvement Plan
WUE	Water Use Efficiency
YMWD	Yuima Municipal Water District

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

0.0 Executive Summary (§354.4(a))

0.1 Introduction

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of AB 1739, SB 1168, and SB 1319, collectively known as the Sustainable Groundwater Management Act (SGMA), providing California with a framework for sustainable groundwater management for the first time in its history. SGMA aims to ensure the reliability and quality of critical groundwater resources throughout the state. Recognizing that groundwater is most efficiently managed at the local level and each groundwater basin is different, the intent of SGMA is to facilitate and strengthen local control and management of groundwater basins. For groundwater basins designated as medium or high priority, SGMA requires the formation of a Groundwater Sustainability Agency (GSA), responsible for developing and implementing a Groundwater Sustainability Plan (GSP) that considers the interests of all beneficial uses and users of groundwater in the basin. SGMA also requires that these basins reach and maintain sustainability within 20 years following plan implementation.

Sustainable groundwater management is defined as the *"…management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results…"* (Water Code Section 10721 (v)). SGMA has identified six sustainability indicators which refer to effects caused by groundwater conditions occurring throughout a basin that, when significant and unreasonable, cause undesirable results (Water Code Section 10721(x)). These are:

- Reduction of Groundwater in Storage
- Chronic Lowering of Groundwater Levels
- Seawater Intrusion
- Degraded Water Quality
- Land Subsidence
- Depletion of Interconnected Surface Water

The goal of the GSP is to ensure that groundwater continues to be available to everyone who uses it far into the future.

The Upper San Luis Rey (USLR) Valley Groundwater Subbasin is a medium-priority basin. As a result, the Pauma Valley GSA was formed and consists of Yuima Municipal Water District (YMWD), Pauma Municipal Water District (Pauma MWD), Pauma Valley Community Services District (CSD), San Luis Rey Municipal Water District (SLRMWD), and the Upper San Luis Rey Resource Conservation District (USLRRCD). The GSA was created to help, not hinder, the effective use of groundwater, and developed this GSP for achieving long-term groundwater sustainability in the basin. The goal of the GSP is to ensure that groundwater continues to be available to everyone who uses it far into the future. The Plan considers the best available scientific data and local knowledge of the basin to describe basin conditions, including the geology of the basin and groundwater levels within it. The Plan also establishes sustainability goals for the basin and outlines steps and potential management actions to ensure sustainability.

The primary sections of the GSP include:

- **Executive Summary** provides a succinct summary of the contents of the GSP.
- **Section 1.0 – Introduction** provides an introduction to the GSP, including objectives of the GSP, agency information, and GSP organization.
- **Section 2.0 – Plan Area** describes the geographic setting, existing water resources planning and programs, relationship of the GSP to other general-plan documents within the basin area, and additional GSP components such as land use plans, well and project permitting processes, control of saline water, and current groundwater projects.
- **Section 3.0 – Basin Setting** describes the physical components of the USLR Valley Groundwater Subbasin and provides a hydrogeologic conceptual model for the understanding of groundwater conditions in the subbasin and development of groundwater budgets.
- **Section 4.0 – Sustainable Management Criteria** describes the sustainability goals set by the GSA, defines undesirable results (URs), minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IMs).
- **Section 5.0 – Monitoring Network** describes the initial monitoring network established and monitored during development of the GSP, recommendations for monitoring network modifications following Plan implementation to improve data coverage in data gap areas, assess sustainability criteria, and evaluate impacts from proposed projects and management actions, and outlines monitoring protocols and field sampling procedures.
- **Section 6.0 – Projects and Management Actions** provides a framework to achieve the sustainability goal for the USLR Valley Groundwater Subbasin by listing potential management actions and/or projects that may be utilized to ensure long-term sustainability, mitigate potential undesirable results, and potentially increase sustainable yield of the subbasin through additional or supplemental recharge.
- **Section 7.0 – Plan Implementation** describes the GSP implementation process, including estimated costs, sources of funding, a preliminary schedule, methodology for annual and five-year reporting, and how progress evaluations will be made over time.

0.2 Plan Area

0.2.1 General Setting and Jurisdictional Area

San Luis Rey Valley Groundwater Basin, located in San Diego County, extends from the confluence of the San Luis Rey River and Paradise Creek, continuing downstream through four valleys (Pauma, Pala, Bonsall, and Mission) and ending at the Pacific Ocean in the City of Oceanside (Figure 0-1). It is classified as subbasin 9-007.01 by the California Department of Water Resources' (DWR) Bulletin 118 (DWR, 2016). Assembly Bill No. 1944, Chapter 255 (AB 1944, 2018), an act to amend Section 10721 of and to add Section

10722.5 to the Water Code, defines the boundary that divides the Upper and Lower San Luis Rey Valley Groundwater Subbasins.

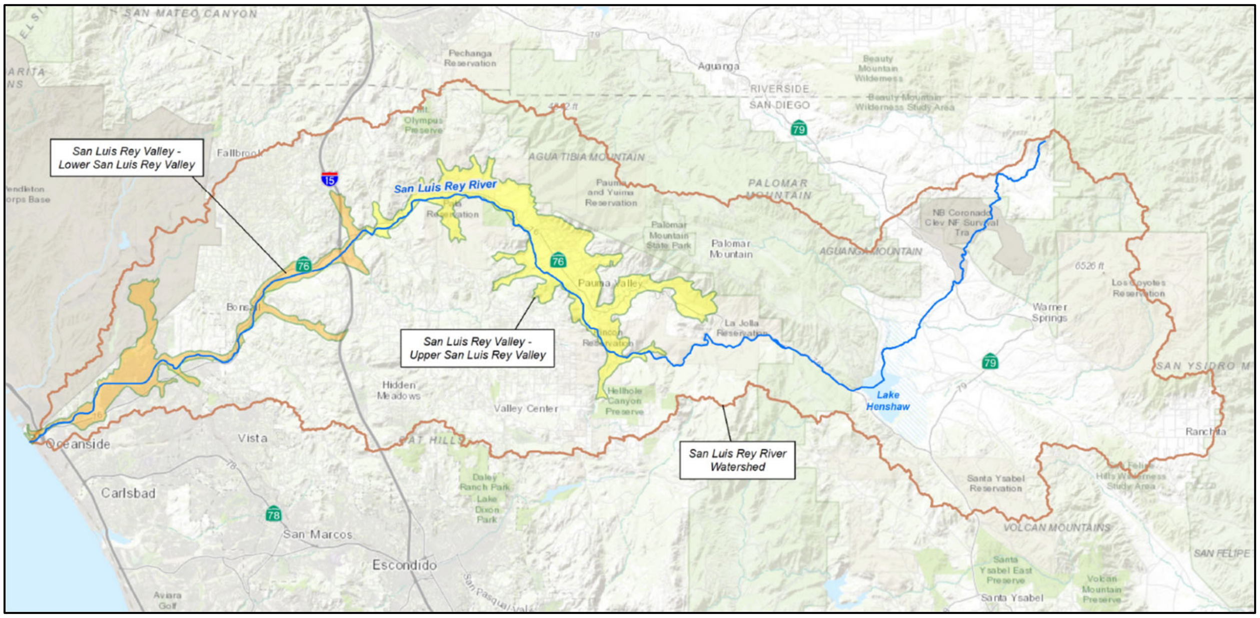

Figure 0-1. Upper San Luis Rey Valley Subbasin Setting

The USLR Valley Groundwater Subbasin can be further subdivided into two subbasins: the Pauma Subbasin and the Pala Subbasin (Figure 0-2). The Pauma Subbasin extends from the confluence of the San Luis Rey River and Paradise Creek to the Agua Tibia Narrows near the confluence of the San Luis Rey River and Frey Creek. The Pala Subbasin extends from the Agua Tibia Narrows to Monserate Narrows. Based on prior decisions by the State of California, groundwater in Pala Subbasin, located downstream of Frey Creek, has been determined to be a subterranean stream flowing through known and definite channels (SWRCB, 2002).

SGMA specifically excludes subterranean streams from its requirements. However, while subterranean streams are generally excluded from SGMA, Assembly Bill 1944 was put forth to include the area of the subbasin downstream from Frey Creek (i.e., Pala Subbasin) as part of SGMA for the purposes of groundwater sustainability. AB 1944 does not alter any existing water right. Therefore, the GSP components address both the Pauma and Pala Subbasins.

There are several water agencies within the Plan Area that serve areas within the subbasin. In addition, the Plan Area includes several Sovereign Tribal Nations that have autonomy over their lands and follow Federal environmental laws and regulations. The La Jolla Band of Luiseno Mission Indians, Rincon Band of Luiseno Mission Indians, Pauma Band of Luiseno Mission Indians, and Pala Band of Luiseno Mission Indians monitor water resources on their respective reservations (RWMG, 2018).

0.2.1.1 Land and Water Use

Land use within Pauma subbasin is predominantly irrigated agriculture/parks/golf (52%), followed by 27% open space/ water, 17% residential, and 4% commercial/ industrial/ public facilities. In Pala Subbasin, land use is approximately 42% open space/ water, 38% irrigated agriculture/ parks, 12% residential, and 8% commercial/ industrial/ public facilities. Likewise, the majority of water use within the subbasin is for agricultural purposes (within the YMWD service area, approximately 91% of the water goes to agricultural use). Sources of water within the USLR Subbasin include groundwater, surface water, and imported water.

- **Groundwater** is produced primarily from the alluvial- (sediment-) filled valley areas, with minor contributions from hard rock/fractured aquifer systems along the edges of and underlying the groundwater subbasin. In 2002, the State Water Resources Control Board (SWRCB) determined that water within Pauma Subbasin, while hydraulically connected to the San Luis Rey River, is percolating groundwater and not part of the river flow as it filters through the ground (Decision 1645). Through the same SWRCB Decision 1645, Pala Subbasin was found to be confined subterranean San Luis Rey River streamflow through known and defined channels. However, for the purposes of SGMA, the technical assessment of groundwater conditions and evaluation of the appropriate management strategies will be applied to the Pala Subbasin with understanding that the GSP has no authority over water rights there.
- **Surface water** flow in the San Luis Rey River, which runs through the USLR Valley Groundwater Subbasin, is largely controlled by operations at Henshaw Dam, which is owned and operated by Vista Irrigation District (VID). The majority of this water is diverted for treatment and use within VID and City of Escondido services areas, as well as for deliveries to the Rincon Band of Luiseno Indians. Several other entities within the USLR Valley Groundwater Subbasin also hold active surface water diversion rights, which are available to view on the Electronic Water Rights Information Management System (eWRIMS).
- **Imported water** use in the Subbasin is made available through YMWD, who receives Colorado River and State Water Project (SWP) supplies via a membership with the San Diego County Water Authority (Water Authority). The Water Authority takes delivery of water from Metropolitan Water District of Southern California (Metropolitan) and transports the water to the YMWD delivery point near Couser Canyon Road in Valley Center, just north of Lilac Tunnel.

0.2.2 Water Resources Monitoring and Management Programs

While local districts have generally maintained records within their individual service areas, there is currently no unified monitoring plan in the Pauma/ Pala Subbasins. This GSP recommends a unified monitoring program to provide accurate and needed information regarding regional groundwater conditions throughout the two subbasins (Section 5.0 Monitoring Network). In addition, future involvement of the local Tribal entities may allow the beneficial incorporation of additional monitoring locations and basin coverage.

In addition, regulatory guidelines, planning recommendations, and other existing documents are currently used to broadly manage Plan Area groundwater and the groundwater surrounding the USLR Valley Subbasin. These management programs and studies have been developed by multiple agencies and organizations for a variety of purposes, but none of them have been specifically developed for the USLR Valley Subbasin. This GSP outlines a localized focus for sustainable groundwater management.

0.2.3 General Plan and Related Land Use Planning

Future land use in the USLR Valley Groundwater Subbasin is anticipated to remain predominantly agricultural. Previous estimates of population growth in the Pauma Subbasin have been on the order of 0.5% per year, or less (Weinberg and Jacoby, 2016a). Considering that only about 2.5% of total Pauma Valley demand is residential, the increase in population growth is expected to be negligible with respect to overall water demand. However, any unforeseen changes in land and/or water use will need to be taken into consideration in future GSP reporting and groundwater management.

0.2.4 Notice and Communication

Under the requirements of SGMA, GSAs must consider interests of all beneficial uses and users of groundwater when developing a GSP. As a result, the GSP development needs to consider effects to other stakeholder groups in or around the groundwater basin with overlapping interests. These interests include, but are not limited to, holders of overlying groundwater rights (including agriculture users and domestic well owners), public water systems, local land use planning agencies, environmental users, surface water users, federal government, California Native American tribes, and disadvantaged communities (DACs).

The GSA would like to hear from well owners and other stakeholders on how ongoing communication and participation could be enhanced in the future.

The development of a GSP is a collaborative process involving all interested stakeholders. Public input is critical to the success of the USLR Valley Subbasin GSP and was a key component of its development. Notification and communication activities for the development of this GSP were guided by the Public Involvement Plan and included several public workshops to review progress throughout the development of the GSP and allow an avenue for incremental feedback. While the GSA's efforts to do community outreach have been proactive, the GSA would still like to hear from well owners and other stakeholders on how ongoing communication and participation could be enhanced in the future. Continued outreach is planned through future management actions and programs.

0.3 Basin Setting

0.3.1 General Setting

As mentioned previously, the USLR Groundwater Subbasin includes the Pauma and Pala Subbasins and encompasses approximately 19,200 acres in San Diego County (Figure 0-2). The valley areas are separated by narrow, steep-walled canyons and underlain by unconsolidated sediments that serve as storage for groundwater. Elevation ranges from approximately 250 ft above mean sea level (amsl) in valley areas to over 5,700 ft amsl in the surrounding watershed area. The majority of land in the groundwater subbasin is used for agriculture, consisting primarily of citrus, avocados, and sub-tropical fruits. The main surface drainage feature in the area is the San Luis Rey River, which flows in a northwesterly direction through Pauma Subbasin and into Pala Subbasin, where it turns to the southwest and flows through the Monserate Narrows and into downgradient Bonsall Subbasin. Vegetation in the Plan Area includes chaparral, coastal sage scrub, and oak woodland.

The general climate of the area is Mediterranean, with warm, dry summers and mild winters, although temperatures do occasionally fall below freezing. Most precipitation falls between the months of November and April with infrequent rain the rest of the year (particularly in summer months). Precipitation is also two to three times greater in the surrounding hills and mountain areas than in the valley areas. Periods of drought (below-average rainfall) punctuated by wet periods are common, making year-to-year rainfall highly variable. Average annual precipitation for the period from 1943 through 2020 is approximately 24.3 inches at the Lake Henshaw precipitation station, which has the most complete and extensive precipitation record available in the vicinity of the USLR Valley Groundwater Subbasin. Since this station is located at a higher elevation than the majority of the groundwater subbasin, precipitation in the valley areas is expected to be less.

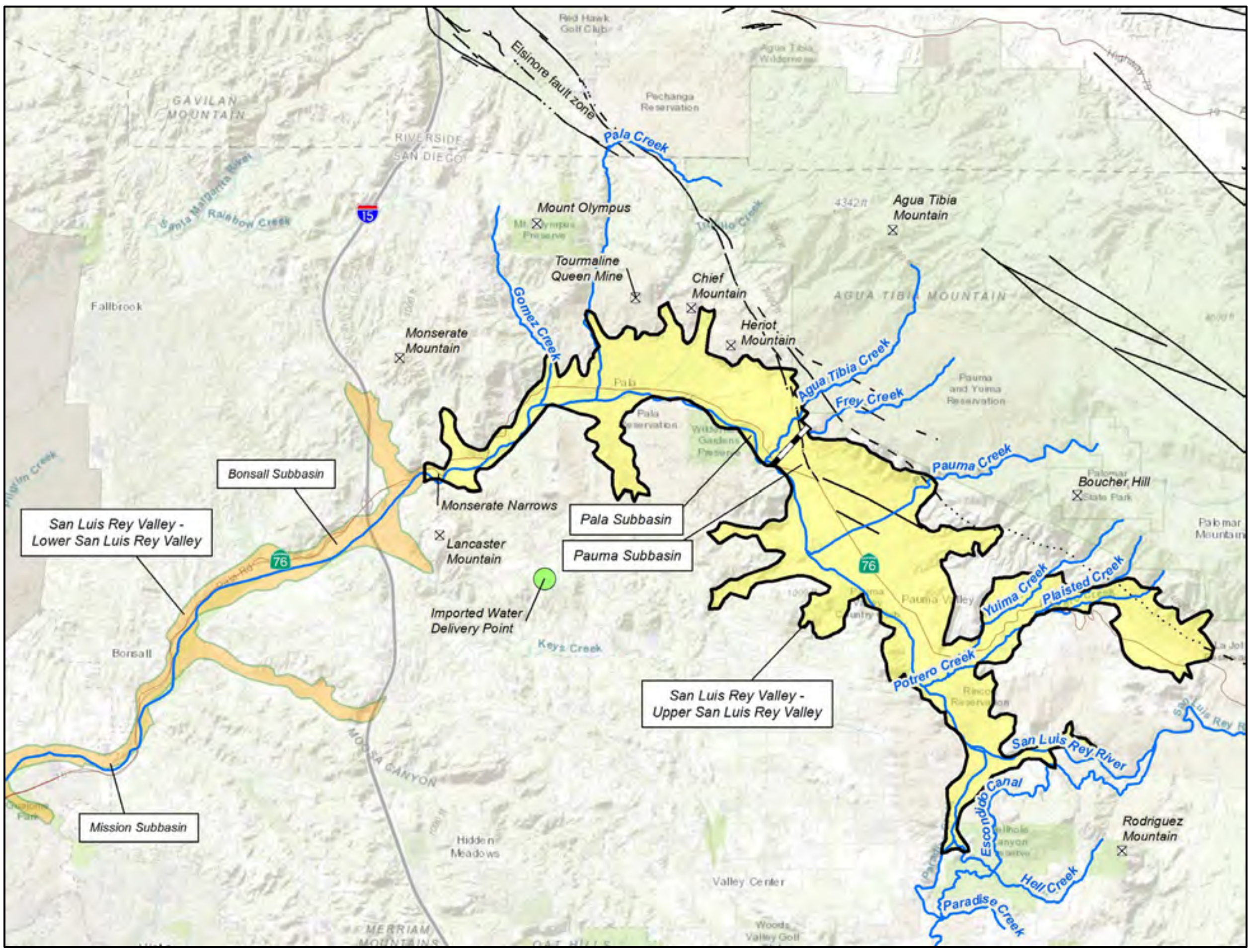

Figure 0-2. Geographic Setting

0.3.2 Geology

The USLR Valley Groundwater Subbasin lies within the Peninsular Ranges Physiographic Province of Southern California, which is characterized by mountainous ridges and hills surrounding valleys and basins. The Peninsular Ranges have been subject to a range of tectonic forces, including faulting, tilting, regional uplift, and subsequent erosion. The main structural feature in the Plan Area is the Elsinore fault zone, which runs northeast of the Valley (Figure 0-2). The Elsinore fault zone represents the westernmost onshore branch of the San Andreas fault system and extends over 200 km from the southern Los Angeles Basin into Mexico (where it becomes known as the Laguna Salada fault). No major earthquakes have occurred along the Elsinore Fault in the USLR Valley Groundwater Basin since the establishment of the Pala Mission in 1816.

The Pala and Pauma Valleys are underlain by valley fill consisting of unconsolidated flood plain and alluvial materials (collectively referred to as "alluvium") deposited by running water and/or weathering and gravity processes. Valley fill is surrounded by and underlain by crystalline bedrock, which is locally fractured (Figure 0-3). The main geologic units found in the USLR Valley Groundwater Subbasin include (from oldest to youngest):

- Bedrock: crystalline rock which provides only limited amounts of groundwater through fractures and joints.
- Older Alluvium: slightly cemented (consolidated) material deposited by surface water flow in the central basin area. Important source of groundwater.
- Lakebed Deposits: silt and clay material thought to be deposited during the last Ice Age when blockage of the San Luis Rey River resulted in an ancient lake covering much of Pauma Subbasin. The fine-grained nature of this geologic unit can restrict groundwater percolation from above.
- Alluvial Fan Deposits: alluvial material of mixed size (fine-grained to very coarse-grained, including boulders) located primarily along the northeastern flanks of the mountains. They generally have lower groundwater yields than the other alluvial materials but are an important source of groundwater recharge.
- Younger Alluvium: recent river channel deposits found along the central basin area.

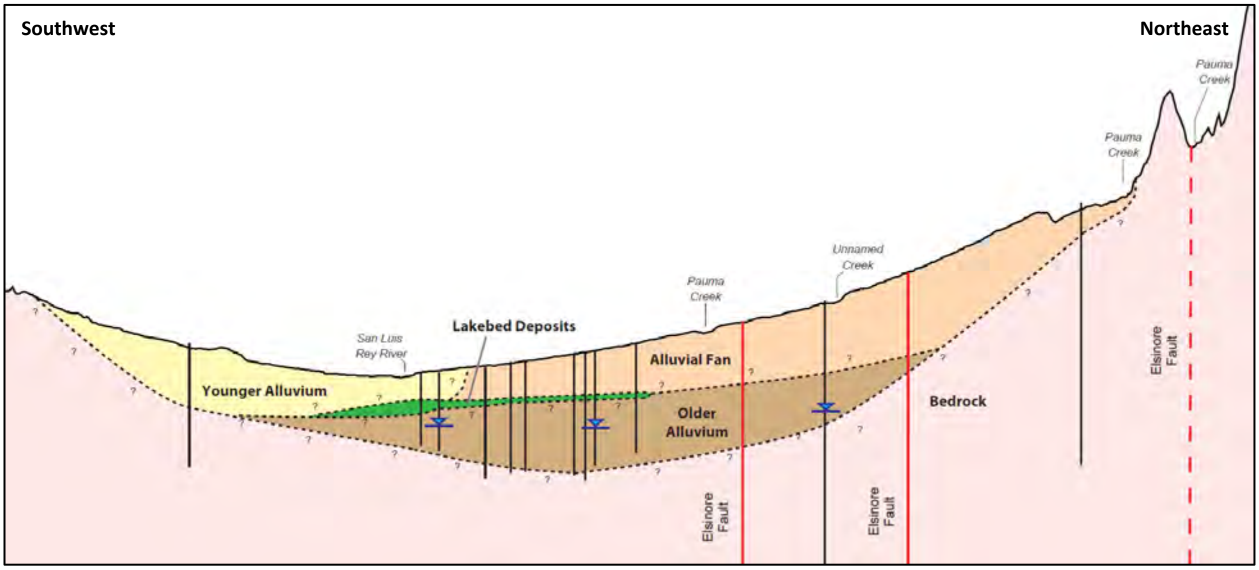

Figure 0-3. Geologic Cross-Section through Pauma Subbasin

0.3.3 Hydrology

0.3.3.1 Basin Boundaries

During the course of developing this GSP, it has been found that the current basin boundaries (as defined through DWR) do not adequately represent the true extent of the groundwater subbasin based on geologic contacts and topographic changes indicating the presence of crystalline bedrock. A process for redefining or refining groundwater basin or subbasin boundaries has been provided to local agencies through SGMA. However, the next basin boundary modification period is not expected before 2022. This GSP has been prepared using the currently-defined subbasin boundaries but sets the foundation for future modifications that would allow the groundwater subbasin boundaries to coincide with the geologic conditions present in the subbasin – particularly along the edges. The proposed boundaries were based on available geologic mapping supplemented by topographic information and aerial imagery.

0.3.3.2 Groundwater Occurrence and Aquifer Systems

The majority of groundwater in the USLR Valley Groundwater Subbasin is produced from the porous flood plain and alluvial material representing valley fill. Productivity generally decreases with decreasing thickness of unconsolidated material. Alluvial sediments in valleys are generally thickest under the San Luis Rey River. In Pauma Valley, sediments may be up to 600 ft thick in localized areas of the northeast portion of the subbasin (Layne, 2010). However, these locations with greater sediment depth typically coincide with alluvial fan deposits, which tend to be less productive. The Pauma and Pala Subbasins are hydraulically connected, with groundwater from the upgradient Pauma Subbasin flowing into Pala Subbasin.

There are also quite a few wells within the valley and foothill areas that tap fracture systems in underlying and surrounding crystalline bedrock. However, due to the typically reduced capacity of these bedrock units to transmit reliable or significant quantities of groundwater to wells, bedrock is not considered to be an aquifer unit within the Plan Area.

The aquifers in the Pauma and Pala Subbasins are used for domestic, agricultural, commercial, and municipal water supply purposes. The majority of urban areas are supplied water by water agencies but there are some private wells that provide water for domestic use. The majority of private pumping is used for agricultural irrigation.

0.3.3.3 Groundwater Recharge and Discharge

Identifying sources and locations of groundwater recharge and discharge is an essential component of the hydrogeologic conceptual model as well as for the development of water budgets for the USLR Valley Groundwater Subbasin. General sources of groundwater inflow (recharge) and outflow (discharge) are summarized in the following table.

Table 0-1. USLR Valley Groundwater Subbasin Inflows and Outflows

	Term	Description
Groundwater Recharge	Recharge from Mountain Front Runoff	Includes both recharge from ungaged surface runoff and subsurface inflow through fractures and faults in the surrounding bedrock. It is assumed to occur along the contact between upgradient outcrops of bedrock and downgradient unconsolidated valley materials.
	Areal Recharge from Precipitation	Refers to the process by which a portion of precipitation falling the ground surface within the basin infiltrates downward beyond the root zone where evapotranspiration (ET) may occur. This deep percolation is assumed to eventually recharge the groundwater system. It is assumed to occur fairly evenly across the valley floor.
	Streambed Percolation	Recharge to groundwater from streamflow percolation. Occurs in the San Luis Rey River and tributary systems when surface flow is present.
	Return Flow from Applied Water	Refers to the amount of water that returns to the groundwater aquifer after application of water to the land surface in the form of irrigation, from leaks in water lines, or septic seepage. This includes the use of groundwater, surface water, and imported water. Occurs throughout the subbasin and varies by application.
	Recycled Water Spreading	The percolation of treated effluent from water treatment facilities. Occurs at the Pauma Valley Treatment Plant, Pauma Casino wastewater treatment plant, and Pala wastewater treatment plant.
Groundwater Discharge	Groundwater Pumping	Pumping of groundwater through wells – represents the primary source of discharge from the USLR Valley Groundwater Subbasin. Pumping records were requested from basin stakeholders as part of the GSP effort and were received from many of the water purveyors in the basin and several large agricultural entities. The remaining unreported groundwater pumping was estimated to be water use not met by reported pumping, based on available well information, land use and crop type/coverage through time obtained from the County Department of Planning and Land Use, or other estimates of water use from previous studies.
	Rising Water Discharge to Surface Flow and Subsurface Outflow	A stream gains or loses water depending on groundwater elevation relative to stream elevation. When stream levels are higher than groundwater levels, the stream loses water to the aquifer through percolation; when groundwater levels rise above stream or land surface elevations, the stream gains water from the aquifer. This is known as rising water. In the USLR Valley Groundwater Subbasin, the main area of rising water is at and before the Monserate Narrows, at the end of Pala Subbasin. Groundwater underflow outflow to Bonsall Subbasin also occurs in the river sediments running through the Monserate Narrows.
	Evapotranspiration (ET)	Includes the consumption of surface and groundwater through evaporation and transpiration by plants. In general, groundwater ET decreases with decreasing groundwater elevation and is the highest in areas where groundwater level elevations approach or exceed the ground surface (where plants can access groundwater).

0.3.3.4 Current and Historical Groundwater Conditions

Contours of groundwater elevation were developed based on available observed water level data. Current groundwater contours (2020) are shown on Figure 0-4. The groundwater elevation contours represent lines of equal elevation on the groundwater surface. Groundwater flow occurs perpendicular (i.e., at 90°) to the elevation contours. As indicated by the figure, there are few available water level data in Pala Subbasin to constrain water level contours, highlighting the need for additional water level data and potential groundwater monitoring.

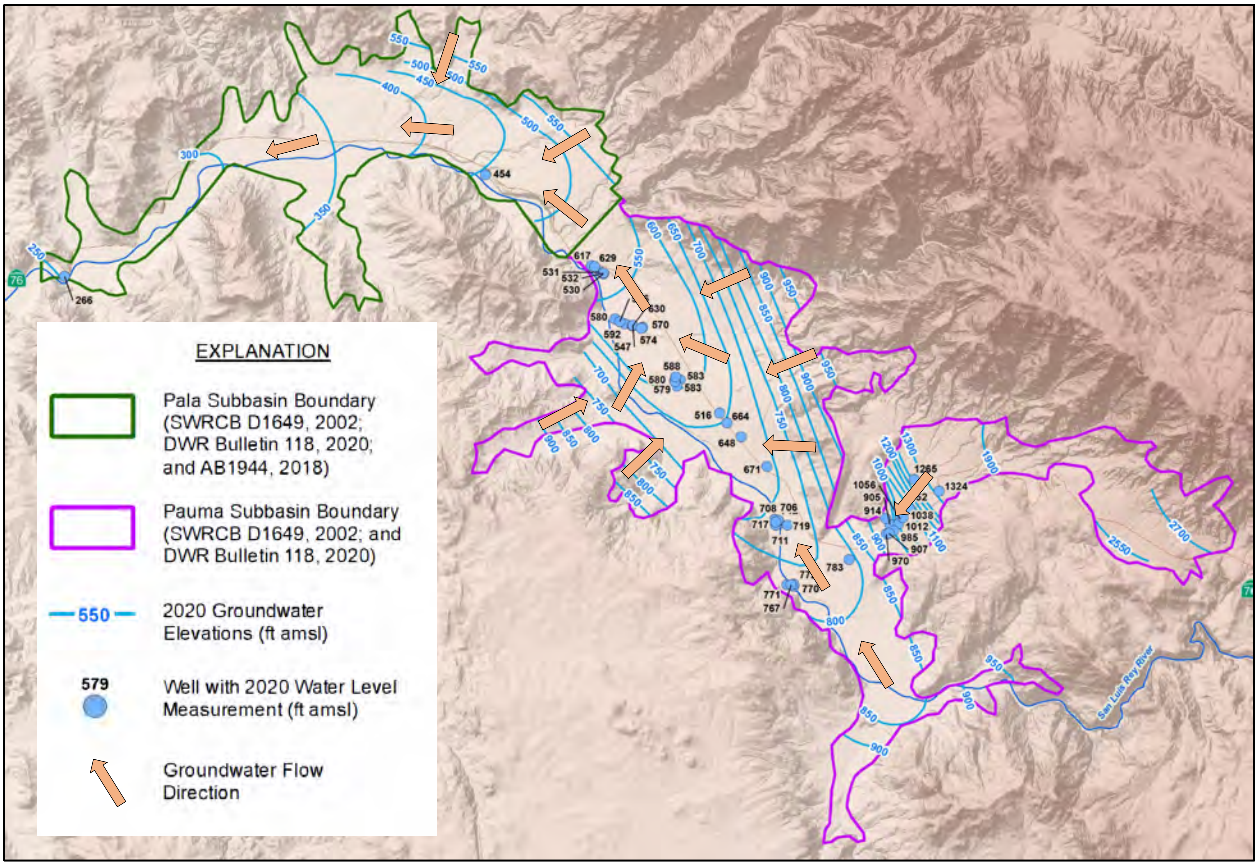

Figure 0-4. Groundwater Elevation and Flow Directions (2020)

Hydrographs, or plots of water level measurements through time, were also assembled from available information. Typical hydrographs for Pauma and Pala Subbasins are shown on Figure 0-5. As shown on the plots groundwater levels in Pauma Subbasin show declines in earlier time periods, such as the late 1980s through the early 1990s. It is thought that these water level declines indicate an increase in agricultural production in the area at a time when imported water deliveries to the subbasin were still relatively small. While less data are available in the Pala Subbasin, the Barona Tribal Authority reported historical low groundwater levels at certain wells in the late 1990s and early 2000s (County, 2010). Declines in water levels were also observed in the 1940s and 1950s (Howes, 1955). Declines in groundwater levels are also typically more pronounced in the alluvial fan areas of the subbasin and tend to be more consistent along the axis of the valleys. Limited data from Pala Subbasin indicate that groundwater levels may be fairly stable.

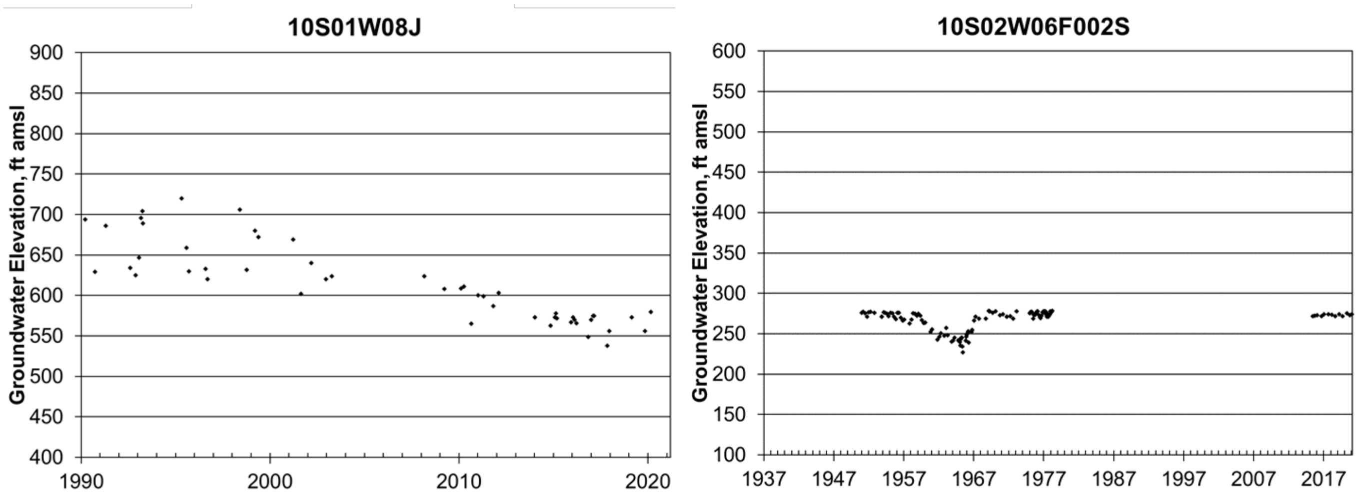

Figure 0-5. Typical Groundwater Hydrographs for Pauma Subbasin (left) and Pala Subbasin (right)

Starting in the early 2000s, water level elevations in Pauma Subbasin generally begin to respond more to trends in precipitation (groundwater elevations stabilize under average hydrologic conditions, increase under wet hydrologic conditions, and decrease when hydrologic conditions are dry). In the last five to ten years in particular, groundwater levels in many parts of the subbasin show recovery. This coincides with average to wet hydrologic conditions and the increased use of imported water (averaging approximately 3,800 acre-ft/yr over the last 10 years).

Therefore, following a period of decline averaging approximately 1 to 4 ft/yr over the last 30 years, groundwater levels in the USLR Groundwater Subbasin appear to have become fairly balanced over the last 10 years or so. In addition, many wells show recent recovery – likely due to a stabilization in land use and the increasing use of supplemental water through imported water deliveries. However, given the current water demand and use, this implies that the continued maintenance of groundwater levels in the subbasin may rely on the continued use of imported water.

0.3.3.5 Groundwater Quality

Most common water quality contaminants in San Diego County include elevated nitrate, naturally occurring radionuclides, total dissolved solids (TDS), and bacteria. Most common sources of anthropogenic contamination include leaking underground fuel tanks, sewer and septic systems, agricultural applications, and facilities with excess animal waste. At present, there are no sites under regulatory clean-up within the USLR Groundwater Subbasin.

TDS is a measure of salinity which accounts for all dissolved solids in water (as milligrams per liter [mg/L]) including organic and suspended solids and is commonly analyzed to determine general suitability for human consumption. A TDS concentration of 500 mg/L is the secondary standard for drinking water established by the U.S. EPA and State Water Resources Control Board. A TDS of greater than 1,000 mg/L is generally considered to be brackish water and not suitable as a potable supply without treatment or blending. The groundwater quality objectives for TDS in the Pauma and Pala Subbasins are 800 and 900 mg/L, respectively. TDS concentrations in the USLR Valley Groundwater Subbasin were evaluated based on available water quality data and recent groundwater quality sampling as part of the initial GSP monitoring network to establish a baseline for groundwater conditions. Historically, TDS in the subbasin ranges from 19.6 mg/L to 1,950 mg/L. Current TDS samples indicate concentrations ranging from 120 mg/L to 1,400 mg/L (Figure 0-6). Current ambient TDS concentration in Pauma Subbasin, taken to the be the median concentration of average water quality in wells with at least three water quality readings from 2015 through 2020, is 607 mg/L.

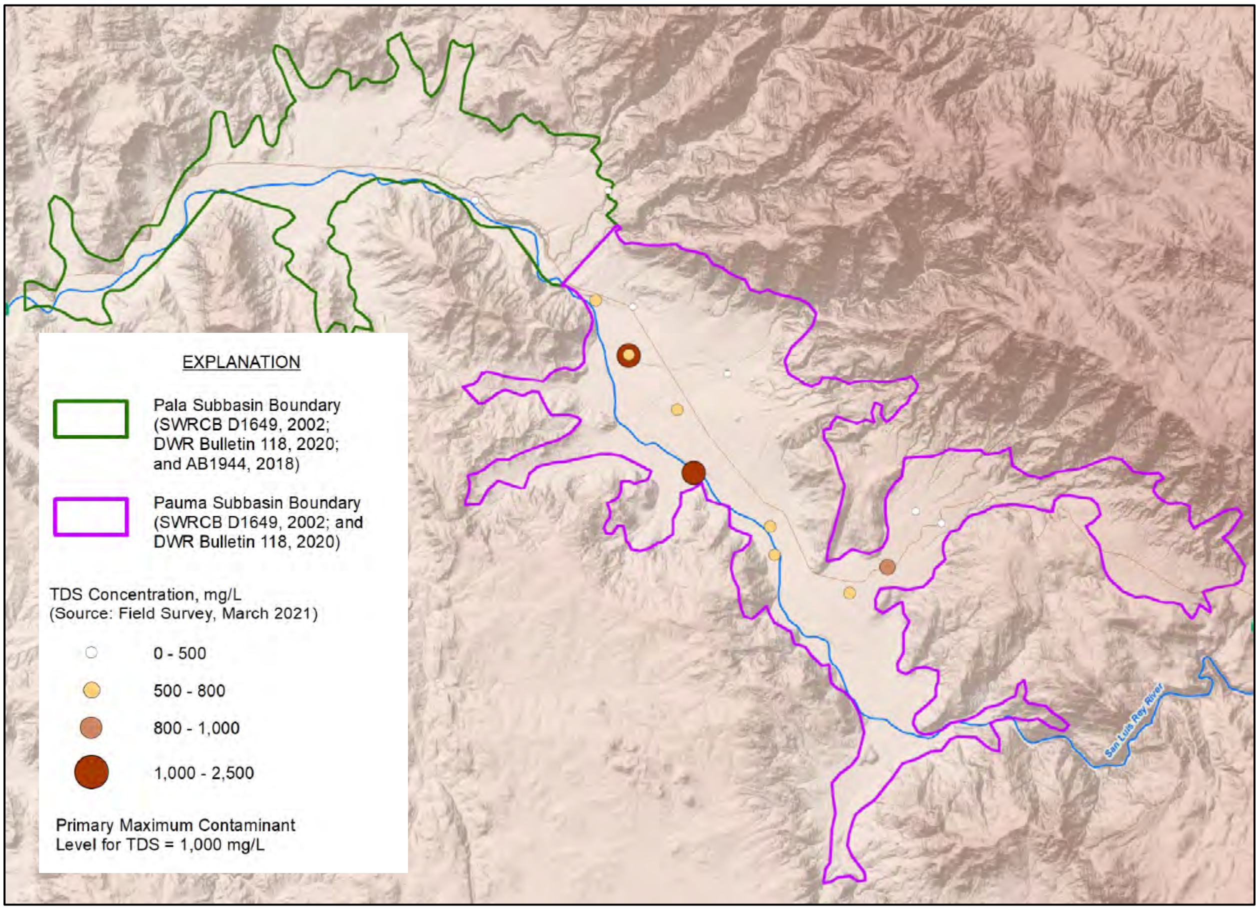

Figure 0-6. Current TDS Concentrations (March 2021)

Nitrate is commonly associated with the industrial process of manufacturing synthetic fertilizers and with agricultural activities, septic systems, confined animal facilities, and wastewater treatment facilities. However, nitrate in water can also be naturally occurring. Nitrate in drinking water is a health concern to both humans and animals, and the State has established an MCL of 10 mg/L for nitrate as nitrogen (N). The State's Public Health Goal (PHG) for nitrate as NO_3 is 45 mg/L (SWRCB, 2020). Historically, nitrate (as N) in the USLR Subbasin ranges from 0.02 mg/L to 29.4 mg/L. Current samples indicate nitrate (as N) concentrations ranging from 1.6 mg/L to 32 mg/L (Figure 0-7). Current ambient nitrate (as N) concentration in Pauma Subbasin is 5.8 mg/L (or 25.8 mg/L nitrate as NO_3).

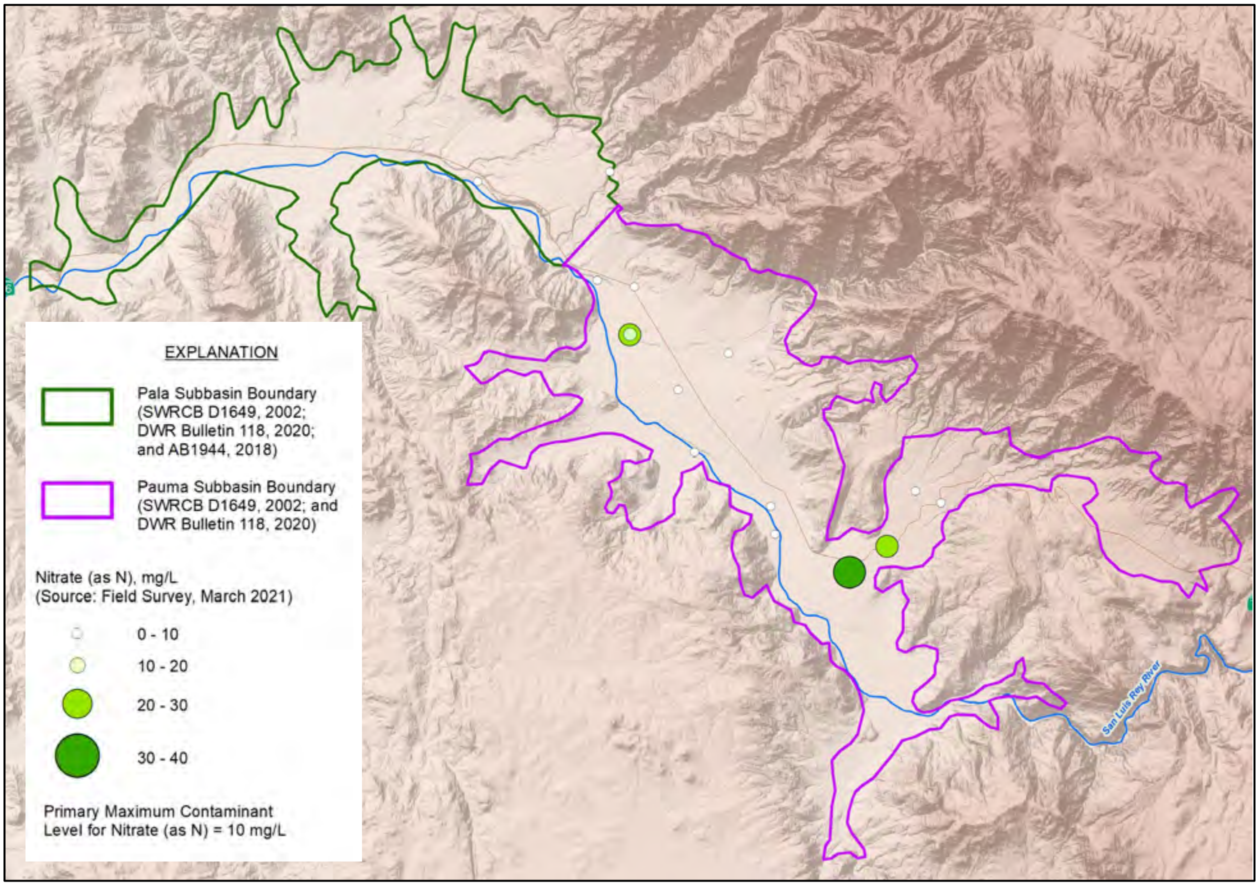

Figure 0-7. Current Nitrate (as N) Concentrations (March 2021)

It is important to note that continuous water quality records within the subbasin are very limited. Recent data (within the last 10 years) is primarily only available in the Pauma Subbasin. The majority of historical data available (from the California Division of Drinking Water's (DDW's) water quality databases) – particularly those in Pala Subbasin and areas overlying reservation lands – represent older records which may not reflect current conditions. The most recent groundwater sampling event for the establishment of GSP monitoring network baseline conditions took place primarily in the Pauma Subbasin and upper portion of Pala Subbasin based on access to wells.

0.3.3.6 Interconnected Surface Water Systems

Given the depth to groundwater in much of the basin, percolation from streamflow is thought to be largely in free fall conditions; that is, the streams are not in direct hydraulic connection with the underlying water table and aquifer system so that surface recharge must percolate through the unsaturated zone before becoming accessible to groundwater pumping. This is especially true for tributaries to the San Luis Rey River (e.g., stream channels crossing alluvial fans). While there are areas within the basin where groundwater has been known to enter the San Luis Rey River (such as in the downgradient Pala Subbasin area where there is standing water), not enough stream flow or groundwater level information near stream channels is available to definitively delineate gaining or losing stream reaches – that is, where streams are interconnected or disconnected from underlying groundwater. This has been identified as a data gap area and additional data collection following GSP implementation will help to develop a better understanding of interconnected surface waters in the basin.

0.3.3.7 Groundwater Dependent Ecosystems

The California Department of Fish and Game reported that riparian vegetation adjacent to the river may have historically supported large populations of wildlife, but no records of fish and wildlife existing in the river prior to construction of Henshaw Dam (in 1922) were found in the Department of Fish and Game files (Case Study Report #76). Since construction of the dam, flows between the dam and Escondido Canal are likely insufficient to support fishery habitat. The USLRRCD has several conservation easements for Arroyo Toads in the USLR Valley Groundwater Subbasin, but these habitat areas are primarily dependent on seasonal surface water and the vernal pools created after storm events and do not appear to be maintained by shallow groundwater. Helix Environmental conducted a desktop study to assess the possibility of groundwater dependent ecosystems (GDEs) in the USLR Valley Groundwater Subbasin, but dependency needs to be verified through field investigation and additional data collection.

0.3.3.8 Seawater Intrusion

Saline water intrusion is typically observed in groundwater basins in closer proximity to the coast (e.g., in downstream reaches of the Lower San Luis Rey Valley Groundwater Subbasin), where lowering of groundwater levels from pumping can reverse the groundwater flow gradient and allow ocean water to flow inland to lower groundwater elevations. Given the distance of the USLR Valley Groundwater Subbasin from the coast, the possibility of saltwater intrusion from the ocean is not considered a threat.

0.3.3.9 Land Subsidence

Land subsidence due to groundwater withdrawal is a long-term, gradual phenomenon that can have lasting effects, even after cessation of pumping. Typically, subsidence occurs as the result of the compaction of fine-grained aquifer units (e.g., clays) due to dewatering of the sediment pores from excessive pumping or groundwater withdrawal, but depends largely on the thickness of clay layers and the length of time declines in water levels have been experienced or observed. Thick layers of clay necessary for land subsidence have not been observed in the USLR Valley Groundwater Subbasin. The only significant accumulation of fine-grained sediments are those from paleo Lake Pauma, which have a maximum thickness of about 10 ft and are not continuous throughout the entire basin. Substantial long-term declines in groundwater elevations have also not been observed, nor have there been any accounts of historical land subsidence or features associated with subsidence (e.g., ground fissuring). Therefore, subsidence potential in the USLR Valley Groundwater Subbasin is considered to be a very low risk.

0.3.3.10 Water Budget Information

A water budget is an accounting of all water that flows into and out of a specified area (i.e., recharge and discharge), including any resulting water storage change. This may be expressed as:

Inflow = Outflow +/- Change in Groundwater Storage

Water budgets were established for the USLR Valley Groundwater Subbasin using a calibrated surface water and groundwater model. The USLR Groundwater Model (USLRGM) includes an integrated watershed, or surface water, modeling component that accounts for surface water processes and was calibrated to available surface flow data from 1991 through 2020. The groundwater model component includes three model layers representing the major geologic units found in the subbasin and was calibrated to observed groundwater elevations for the same period. Model calibration refers to the process of iteratively changing aquifer parameters (like fluid transmission rates or hydraulic conductivity) within physically reasonable limits to obtain a good match between model-predicted water levels (or streamflow in the case of the surface water modeling component).

Surface water and groundwater modeling inflow and outflow terms were developed based on the best available data and information (either directly or estimated based on typical modeling methodology). The use of a calibrated groundwater model provides a valuable tool for estimating water budgets since data availability is limited in the subbasin – both geographically (through space) and temporally (through time). The model provides an important check for inflow and outflow term estimates because annual values for these terms must collectively be able to produce simulated water levels and surface flow that closely match observed values. Water budgets were established for historical, current, and future conditions as follows:

- The **historical water budget** for the USLR Valley Groundwater Subbasin was evaluated over the model calibration period from January 1991 through December 2020. This 30-year period represents average hydrologic conditions (with an average precipitation of 24.8 inches per year compared to a long-term average of 24.3 inches per year from 1943 through 2020) and includes both dry and wet hydrologic periods. In addition, it represents the period of time for which information – such as water level and pumping data – becomes more readily available.
- The **current water budget** for the USLR Valley Groundwater Subbasin was determined using the same approaches used for the historical water budget, but over the last five years (i.e., 2016 through 2020). Hydrology (i.e., precipitation) during this period is slightly higher than the long-term average precipitation observed at Henshaw Dam: 25.7 inches versus 24.3 inches. This above average rainfall contributes additional groundwater recharge and less groundwater demand.
- Since land use in the USLR Valley Groundwater Subbasin is not anticipated to change much and no projects or significant changes in water use are currently known, the **future water budget** for the USLR Valley Groundwater Subbasin was evaluated using current land use conditions and the average pumping/imported water use over the last five years. These operational conditions were evaluated over a 60-year period (i.e., 2022 through 2081) of average hydrology representing the period from 1991 through 2020 repeated twice.

Average annual inflow and outflow for the USLR Valley Groundwater Subbasin for the various water budget periods are summarized in the following table.

Table 0-2. Upper San Luis Rey Valley Groundwater Basin – Groundwater Budgets

	Term	Historical (1991-2020)	Current (2016-2020)	Projected (2022-2081)
		Annual Average [acre-ft/yr]		
Inflow	Recharge from Mountain Front Runoff	7,051	9,262	7,051
Inflow	Areal Recharge from Precipitation	3,790	4,942	3,790
Inflow	Streambed Percolation	6,007	10,662	6,914
Inflow	Return Flow from Applied Water	2,689	2,320	2,483
Inflow	Recycled Water Spreading	228	295	295
Inflow	**Total Inflow**	**19,765**	**27,481**	**20,532**
Outflow	Groundwater Pumping	14,263	12,235	13,659
Outflow	Subsurface Outflow	4,780	5,008	4,858
Outflow	Evapotranspiration (ET)	2,269	2,126	2,123
Outflow	**Total Outflow**	**21,313**	**19,369**	**20,641**
	Change in Groundwater Storage	**-1,548**	**8,111**	**-109**

As shown in the table above, annual change in groundwater storage during the period from 1991 through 2020 was estimated to be -1,548 acre-ft/yr. This storage decline is reflected in observed water levels in the basin, especially Pauma Subbasin, which show general groundwater declines from the 1990s until the last 10 years or so. The change in storage estimated under current water budget conditions also supports the water levels observed throughout much of the basin, which indicate a recovery in recent water levels and groundwater storage. A combination of above average precipitation and increased use of imported water has allowed groundwater storage to recover by over 8,000 acre-ft/yr for the last five years. A continuation of current water use practices in the basin for the next 60 years, assuming average hydrologic conditions, is anticipated to cause additional groundwater storage declines of approximately 100 acre-ft/yr. This indicates that current pumping conditions are approximately equal to the sustainable yield of the basin. Additional groundwater management actions, such as water conservation or imported water use (see Section 4.0) may be able to mitigate the slight projected depletion of groundwater storage. However, as mentioned previously, any changes in projected water use (especially increased pumping) will cause changes in the projected water budget that will need to be addressed through additional projects and/or management actions.

Groundwater modeling indicates that the Upper San Luis Rey Valley Groundwater Subbasin is currently being operated within sustainable limits.

0.3.3.10.1 Estimate of Sustainable Yield

Sustainable yield is defined by Assembly Bill 1944 as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result. In the USLR Valley Groundwater Subbasin, the chronic lowering of groundwater levels and significant and/or unreasonable reduction of groundwater storage would represent the primary undesirable results. Therefore, sustainable yield for the USLR Valley Groundwater Subbasin was considered to be the amount of groundwater pumping achievable with no change in groundwater storage and is summarized in the following table.

Table 0-3. Estimates of Sustainable Yield for the Upper San Luis Rey Valley Groundwater Subbasin

Period	Groundwater Pumping	Change in Storage	Sustainable Yield
		[acre-ft/yr]	
Historical Period (1991 – 2020)	14,300	-1,500	12,700
Current Period (2016 – 2020)	12,200	8,100	20,300
Projected Period (2022 – 2081)	13,700	-100	13,600

The historical sustainable yield value of 12,700 acre-ft/yr represents an estimate of pumping that will result in no long-term depletion of groundwater storage for representative, long-term average hydrologic conditions. However, sustainable yield is not a constant value. Due to changes in annual precipitation – and therefore natural recharge – sustainable yield can be assumed to fluctuate annually. In addition, sustainable yield varies depending on cultural conditions in the subbasin, such as changes in land use within the subbasin and irrigation practices, water supply sources (native vs. supplemental), and water management programs (increased use of recycled water or surface water, etc.). This is apparent in estimates of sustainable yield using current groundwater budgets. Under the conditions experienced over the last five years, sustainable yield is estimated to be closer to 20,300 acre-ft/yr. If current water use and land use continues into the future, sustainable yield is estimated to be approximately 13,600 acre-ft/yr.

Future changes in these conditions should be considered through periodic future updates of sustainable yield estimates. An opportunity to refine sustainable yield estimates for the USLR Valley Groundwater Subbasin is provided through future SGMA-required reporting. These reports will incorporate additional metered flows, providing a better indication of actual groundwater pumping, and supplemental water levels established by the proposed monitoring network (Section 5.0).

Recharge from the use of imported water can increase the amount of groundwater available for pumping in the Subbasin.

0.3.3.10.2 Quantification of Overdraft

A groundwater basin is generally regarded as being in overdraft when pumping exceeds natural and artificial groundwater recharge. As presented above, the preliminary estimate of sustainable yield for the

USLR Valley Groundwater Subbasin is approximately 12,700 acre-ft/yr. This value indicates that historical pumping rates of 14,300 acre-ft/yr were in excess of sustainable yield by approximately 1,500 acre-ft/yr. This additional pumping resulted in observed water level and groundwater storage declines. Current pumping, however, is estimated to be below the estimated historical sustainable yield of 12,700 acre-ft/yr. Lower pumping rates, in conjunction with average to wet hydrological conditions, has contributed to increases in groundwater levels seen in many parts of the basin within the last five to ten years. It is important to note that these pumping and sustainable yield numbers still need to be verified through additional data collection and model refinement. Additional pumping data can be used to verify pumping estimates and associated assumptions and allow for the refinement and recalibration of the groundwater model that will, in turn, improve confidence in sustainable yield estimates.

0.4 Sustainable Management Criteria

DWR states *that "SGMA requires local agencies to develop and implement GSPs that achieve sustainable groundwater management by implementing projects and management actions intended to ensure that the basin is operated within its sustainable yield by avoiding undesirable results"* (DWR, 2016). A GSP must also develop quantitative sustainability criteria that allow a GSA to define, measure, and track sustainable management for the sustainability indicators introduced in Section 0.1. However, based on the hydrogeologic conceptual model, seawater intrusion and subsidence are not likely to occur in the USLR Subbasin and no sustainability management criteria were therefore developed for these criteria. Evidence of or potential for land subsidence and seawater intrusion will be reevaluated and/or verified in the five-year report.

Sustainability criteria include the following:

- Undesirable Result (UR) – significant and unreasonable conditions for any of the six sustainability indicators.
- Minimum Threshold (MT) – numeric value used to define undesirable results for each sustainability indicator.
- Measurable Objective (MO) – specific, quantifiable goal to track the performance of sustainable management.
- Interim Milestone (IM) – target value representing measurable groundwater conditions, in increments of five years, set by the GSA as part of the GSP.

The sustainability goal for the USLR Subbasin is to manage and preserve its groundwater resource as a sustainable water supply. To the greatest extent possible, the goal is to preserve historic operations of beneficial use in the basin as well as allow for future planned uses as conceived by the GSA and basin stakeholders. The sustainability goal will be accomplished by achieving the following objectives:

- Operate the USLR Subbasin groundwater resource within the sustainable yield.
- Implement projects and management actions to reduce USLR Subbasin groundwater demands, increase efficient use of current supplies, maximize use of supplemental water supplies, and mitigate undesirable results.

- Actively monitor the USLR Subbasin and adaptively manage projects and management actions to ensure the GSP is effective and that undesirable results are avoided.

Sustainable management involves the use and management of groundwater without causing undesirable results, but it does not necessarily include reversing natural undesirable conditions. In the USLR Subbasin, no undesirable results are currently present nor have been reported historically. Proposed management actions outlined the GSP will further ensure that undesirable results do not occur in the subbasin going forward. Sustainability criteria were developed for representative monitoring sites (RMSs) within Pauma Subbasin, which represent a subset of the wells in the preliminary monitoring program (Figure 0-8). These wells were chosen to provide a sufficient distribution throughout the subbasin, have known well construction details, are operational/pumping wells that may be impacted by undesirable results, and have screened intervals representative of aquifer material. Evaluation of groundwater conditions at these sites will be used to show progress towards sustainability, provide early identification of potential problems as they might arise, and allow for timely appropriate decisions to be made regarding additional or modified management actions and projects.

At the moment, wells in the monitoring network are largely represented by municipal and agricultural supply wells. It is acknowledged that current sustainability criteria may not be protective of all domestic wells in the basin for which information is largely unavailable. Therefore, additional data will need to be collected following implementation of the GSP to understand where these wells are located, how they operate, and what historical conditions have been in order to determine how beneficial use at these locations can be protected. At the five-year review period, it may be necessary to adjust sustainability management criteria for water levels to accommodate new information about domestic wells and water use.

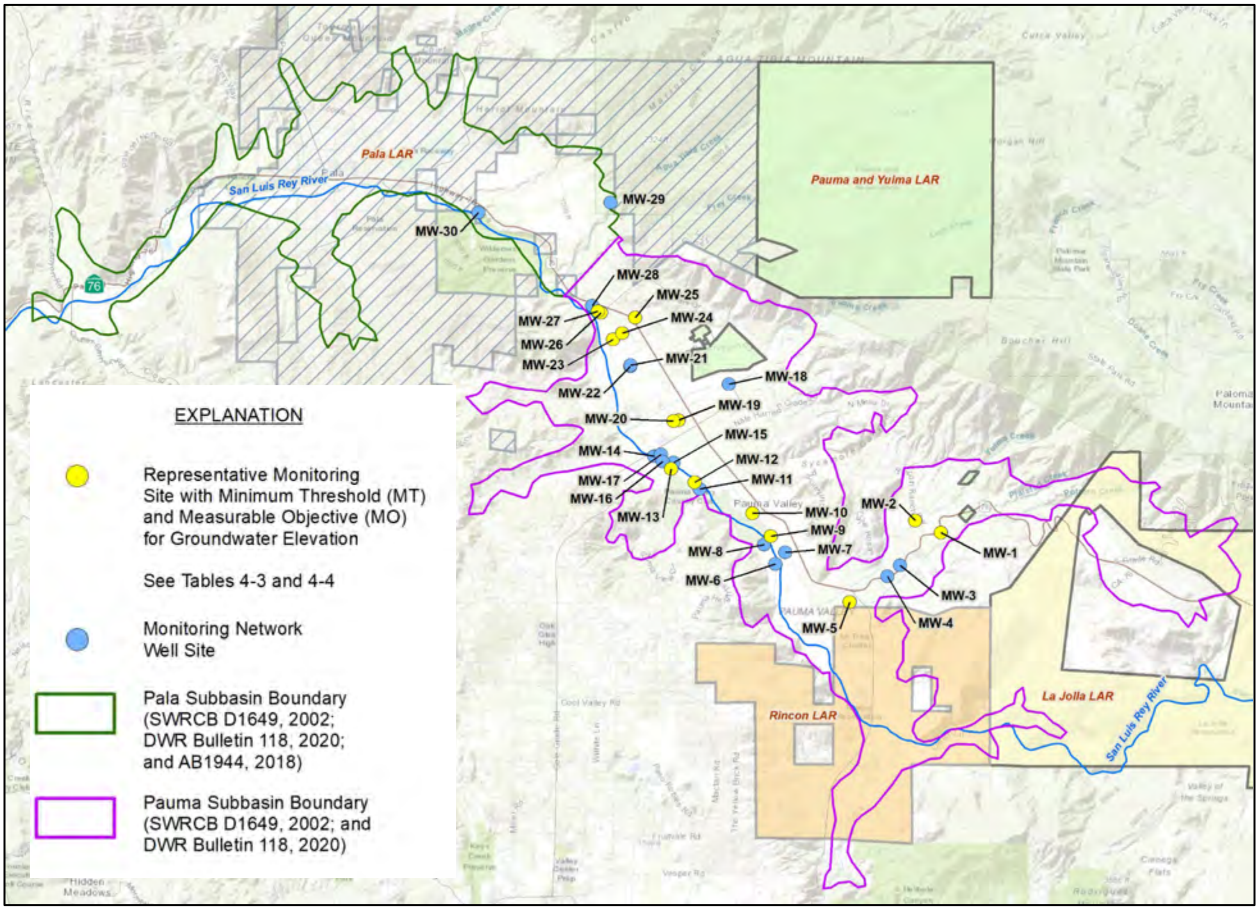

Figure 0-8. Wells in Current Monitoring Network and Representative Monitoring Sites

A summary of the sustainability criteria as relevant to USLR Subbasin and as guided by the Sustainability Goal is provided in the table below.

Table 0-4. Upper San Luis Rey Groundwater Subbasin – Summary of Sustainable Management Criteria

Sustainability Indicator	Undesirable Result	Minimum Threshold	Measurable Objective	Interim Milestone
Groundwater Levels	Groundwater levels at the elevation of current pump settings in representative wells (wells with known construction details and historical water level elevations)	Set at wells by operators as lowest operational level[1]	Elevation representing 3-years of groundwater in storage (approximately 50 ft above MT elevations)[1]	IMs for wells with water levels below the MOs will be determined at 5-year reporting after consistent data collection, refinement of groundwater model, and updated analysis of basin storage to evaluate, if appropriate, the quantity of water needed to reach MO elevations
Groundwater in Storage	Groundwater in storage when water levels are at the elevation of current pump settings	Groundwater in storage at MTs for groundwater levels	3-years of groundwater in storage (approximately 54,000 acre-ft)	To be determined at 5-year reporting period based on refinement of groundwater model and analysis of basin storage from expanded data collection
Interconnected Surface Water/ Groundwater	Groundwater levels fall below the lowest groundwater level since 2015 in identified areas with potentially dependent vegetation	Lowest groundwater level since 2015 in identified areas with potentially dependent vegetation	Maintain seasonal groundwater levels since 2015 in identified areas with potentially dependent vegetation	Based on model-simulated hydrographs, none may be needed. This will need to be confirmed through additional monitoring
Groundwater Quality	TDS and Nitrate above Basin Objectives (800 mg/L for TDS, 45 mg/L for Nitrate as NO_3)	Basin Objectives	TDS and Nitrate as NO_3 at current ambient concentrations (assumed to be the median of available basin wide concentrations: 607 mg/L for TDS, 25.8 mg/L for Nitrate as NO_3)	Current TDS and Nitrate concentrations are at the measurable objectives
Subsidence	Not applicable	Not applicable	Not applicable	Evidence of or potential for land subsidence will be reevaluated in the 5-year report
Seawater Intrusion	Not applicable	Not applicable	Not applicable	The absence of seawater intrusion will be verified in the 5-year report

0.5 Monitoring Network

Groundwater monitoring is key to SGMA compliance as it provides the basis to evaluate groundwater level trends for sustainability and can be used to demonstrate measured progress toward achieving sustainability goals through implementation of the GSP. During development of the GSP, available well information was reviewed to identify wells in the groundwater basin that would provide a good foundation for characterizing current groundwater conditions and which could be used for future, on-going monitoring after GSP implementation. 30 existing wells were identified that were available for the monitoring and sampling conducted in 2021 for the GSP (Figure 0-8). These include pumping wells owned and operated by various water agencies and private agricultural operations. At present, no de minimis users have come forward in response to requests for well information or following discussion at GSP workshops. Using existing wells reduces GSP implementation costs by minimizing costs associated with drilling new monitoring wells.

The monitoring network for the USLR Valley GSP was designed to provide sufficient data from the basin to establish current (ambient) conditions for basin characterization and demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions. After implementation of the GSP, the monitoring network will also provide representative data to evaluate GSP sustainability indicators and objectives, including groundwater levels, groundwater storage, water quality, and depletions in interconnected surface water, in accordance with the specific sustainability goals established by the GSA. A periodic re-evaluation of the representative monitoring sites (RMSs) will be conducted as data are collected and analyzed.

0.5.1 Data Gaps

Available data was limited to those available on public sites (e.g., CASGEM, GAMA, USGS, etc.) and provided as part of the data request made during the development of the GSP. No information for wells on tribal land was provided and data for shallow domestic users are needed. Tribal cooperation and data sharing with regards to tribal wells, tribal surface water diversions, and groundwater levels in the Pala Subbasin will be paramount if the PVGSA is to prevent undesirable results while fully respecting FRWR in the Pala Subbasin. Collection of additional data, including information on domestic wells, surface water flows, water level, water quality, pumping, and precipitation data, from existing or new monitoring locations will greatly improve understanding of Subbasin conditions and allow the PVGSA to revise estimates of sustainable yield, evaluate sustainability criteria, and track ongoing progress towards maintaining groundwater basin operations within sustainable limits.

0.5.2 Recommendations

Potential recommendations and/or changes to the current monitoring network include:

- Adding additional dedicated monitoring well(s) to data gap areas.
- Incorporating existing wells into the monitoring network to provide additional coverage in data gap areas.
- Refining the current network to streamline sampling and make more efficient use of monitoring efforts.
- Install stream and surface flow gauging stations to understand surface conditions and interconnected groundwater/surface water.
- Conduct field monitoring to evaluate riparian habitat and degree of groundwater dependence.
- Evaluate the feasibility of installing a California Irrigation Monitoring Information System (CIMIS) station within the Subbasin to provide localized climate information.

0.5.3 Sampling and Analysis Plan (SAP)

This SAP provided in the GSP outlines all field sampling procedures (groundwater level measurement and water quality sample collection methodology), Quality Assurance and Quality Control (QA/QC), and reporting procedures to be used for the GSP monitoring program. Static groundwater levels and water quality will be measured twice per year: once in the spring and once in the fall, to represent seasonal high and seasonal low, respectively. Additional monitoring events may be conducted on an as needed basis to monitor areas of interest.

0.6 Projects and Management Actions

As discussed in the Basin Setting, the USLR Groundwater Subbasin is generally operating sustainably under current water demand and water supply conditions. While groundwater levels show a period of decline from the 1990s through the early 2000s, increased imported water usage in conjunction with average to wet hydrological conditions have contributed to the stabilization or increase in groundwater levels within the last five to ten years. However, future unanticipated increases in water demand and/or reduced imported water supplies could result in the subbasin falling out of sustainable management. Projects and management actions that support the efficient use of groundwater resources and increase basin recharge will help the USLR Groundwater Subbasin remain sustainable through normal and drought hydrologic conditions.

0.6.1 Current Management Actions

- Agricultural Management Plan and Best Management Practices (BMPs): During development of the GSP, input from representative agricultural users indicated that growers have already enacted water conservation techniques such as using micro sprinklers/drip for irrigation, adjusting watering timing/schedules, regulating irrigation system pressure, and the removal or canopy reduction of low-producing areas – all of which are outlined in the 2016 San Diego Regional Agricultural Water Management Plan (RAWMP) prepared by the San Diego County Farm Bureau (SDCFB).
- Drought Response Conservation Program: Currently, efforts to reduce water demand in the subbasin through conservation are increased during times of drought. For example, YMWD institutes a drought response conservation program to delay or avoid implementing measures such as water rationing or more restrictive water use regulations pursuant to a declared water shortage emergency. Recent water consumption data have also indicated that YMWD customers have reduced water usage from 7 to 16% over the last year alone (2021 versus 2020).
- Groundwater Level and Water Quality Monitoring: Groundwater level and water quality monitoring programs are essential for effective management of groundwater resources and evaluating sustainability. While local districts have generally maintained records within their individual service areas, a unified monitoring effort will provide a holistic view of the subbasin and allow the GSA to identify and adapt to changing conditions before undesirable results are encountered. In addition, it is hoped that future involvement of local tribal entities may allow for even greater understanding of groundwater conditions through the incorporation of additional monitoring locations – to the benefit of all users.

0.6.2 Additional Data Collection

Since understanding the amount of groundwater pumping in the basin is a crucial aspect in establishing long-term sustainability, the GSA plans to initiate pumping record collection efforts upon implementation of the GSP. This would include registration of each groundwater extraction facility within the management area of the GSA, and annual reporting of groundwater extractions (with the exception of de minimis users). Efforts are anticipated to be voluntary at first but, recognizing the importance of understanding pumping amounts for managing long-term sustainability, a metering program will likely be evaluated. Updated pumping records will allow estimates of sustainable yield to be refined and update and recalibrate the integrated surface water and groundwater model of the subbasin, which can be used to evaluate effects of proposed projects and management actions through feasibility studies.

> **The Plan makes use of the best available data. Additional data collection will allow the GSA to better manage this critical groundwater resource and reduce uncertainty.**

0.6.3 Potential Future Management Actions/Projects

The GSA intends to take an adaptive management approach in the USLR Groundwater Subbasin. Frequent assessment of progress towards maintaining sustainability would allow the GSA to proactively enact management actions and/or projects as needed to curb any potential issues before they lead to undesirable results. If basin monitoring indicates that additional action is necessary, the GSA will research the feasibility of implementing supplementary management actions and/or projects. For planning purposes, proposed projects and management actions have been grouped into four tiers, generally corresponding to the order of potential implementation (i.e., projects and management actions in Tier 1 are anticipated to be considered before those in Tier 2, etc.). Potential projects are listed below.

Tier 1 Projects/Management Actions

- Convening an Interactive Tribal Work Group
- Convening a Drought Resilience Work Group
- Adaptive groundwater management
- Ongoing groundwater level and water quality monitoring
- Agricultural management plan and best management practices
- Install local CIMIS station
- Water conservation activities
  - Community outreach
  - Irrigation efficiency and best management practices
- Outreach to San Diego County to layout a framework for GSA collaboration
- Pumping record collection
- Well registration and meter installation

Tier 2 Projects/Management Actions

- Water conservation activities:
  - Rebate programs
  - Rainwater capture
  - Crop swap programs
  - Low impact development standards for new or retrofitted construction
  - Leak detection assessment
  - Voluntary fallowing
  - Identify new sources of funding for all potential management actions
- Indirect recharge through decreased evapotranspiration

Tier 3 Projects/Management Actions

- In-lieu groundwater recharge
- Outreach to VID/City of Escondido/Rincon to explore potential supplemental water supplies for in-lieu use or managed recharge
- Stormwater and/or dry weather capture
- Aquifer Storage and Recovery (ASR)/managed aquifer recharge

Tier 4 Projects/Management Actions

- Groundwater pumping curtailment/allocation (although recognized as an effective tool for achieving groundwater sustainability, pumping restrictions represent a last resort effort and would only be considered by the GSA in the event that other projects and management actions are unable to allow the subbasin to be managed within sustainability goals).

0.7 Plan Implementation

Implementation of the GSP requires robust administrative and financing structures, with adequate staff and funding to ensure compliance with SGMA. A conceptual planning-level cost of about $8,566,000 was estimated for planned activities during the first five years of implementation, or an estimated cost of approximately $1,713,000 per year. This cost estimate reflects routine administrative operations, monitoring, public outreach, reporting, and potential implementation of select Tier 1 basin wide and area-specific management actions. The GSA is developing a Joint Power Authority (JPA) that will go into place within one to two months following GSP submittal. JPA member agencies will cover initial costs until a permanent source of funding is established (e.g., water use tax or fee) to be developed as a Tier 1 action. The GSA plans to conduct focused public outreach and hold meetings to educate and solicit input on the proposed fee structure and plan to begin developing the fee structure as soon as administratively feasible after GSP adoption.

In addition, the GSP calls for GSAs to routinely provide information to the public about GSP implementation and progress towards sustainability and the need to use groundwater efficiently. This includes providing annual and five-year reporting. SGMA regulations require the GSA to evaluate this GSP at least every five years and whenever the Plan is amended and provide a written assessment to the DWR. The GSP calls for a website to be maintained as a communication tool for posting data, reports and meeting information. The website may also include forms for on-line reporting of information needed by the GSAs (e.g., annual pumping amounts) and an interactive mapping function for viewing Subbasin features and monitoring information.

The Plan is a living document that will continue to be updated as additional/better data become available.

1.0 Introduction (§354.2)

On September 16, 2014, Governor Jerry Brown signed into law a three-bill legislative package, composed of AB 1739, SB 1168, and SB 1319, collectively known as the Sustainable Groundwater Management Act (SGMA), providing California with a framework for sustainable groundwater management for the first time in its history. SGMA aims to ensure the reliability and quality of critical groundwater resources throughout the state. Recognizing that groundwater is most efficiently managed at the local level and each groundwater basin is different, the intent of SGMA is to facilitate and strengthen local control and management of groundwater basins. For groundwater basins designated as medium or high priority, SGMA requires the formation of a Groundwater Sustainability Agency (GSA), responsible for developing and implementing a Groundwater Sustainability Plan (GSP) that considers the interests of all beneficial uses and users of groundwater in the basin. SGMA also requires that these basins reach and maintain sustainability within 20 years following plan implementation.

1.1 GSP Objectives

The Upper San Luis Rey (USLR) Valley Groundwater Subbasin is a medium-priority basin. As a result, the Pauma Valley GSA (PVGSA), consisting of Yuima Municipal Water District (YMWD), Pauma Municipal Water District (Pauma MWD), Pauma Valley Community Services District (CSD), San Luis Rey Municipal Water District (SLRMWD), and the Upper San Luis Rey Resource Conservation District (USLRRCD), developed this GSP for achieving long-term groundwater sustainability in the basin. It considers scientific data and local knowledge of the basin and describes basin conditions, including the geology of the basin and groundwater levels within it. The Plan also establishes sustainability goals for the basin and outlines steps and potential management actions to ensure sustainability.

1.2 GSP Organization and Preparation Checklist

Organization of this GSP generally follows the outline provided by the California Department of Water Resources (DWR). A description of each section is provided below. The SGMA regulation relevant to each subsection is specified in parentheses at the end of each sub-heading and a complete checklist is included as Appendix 1a.

- **Executive Summary** provides a succinct summary of the contents of the GSP.
- **Section 1.0 – Introduction** provides an introduction to the GSP, including objectives of the GSP, agency information, and GSP organization.
- **Section 2.0 – Plan Area** describes the geographic setting, existing water resources planning and programs, relationship of the GSP to other general-plan documents within the basin area, and additional GSP components such as land use plans, well and project permitting processes, control of saline water, and current groundwater projects.
- **Section 3.0 – Basin Setting** describes the physical components of the USLR Valley Groundwater Subbasin and provides a hydrogeologic conceptual model for the understanding of groundwater conditions in the subbasin and development of groundwater budgets.

- **Section 4.0 – Sustainable Management Criteria** describes the sustainability goals set by the GSA, defines undesirable results (URs), minimum thresholds (MTs), measurable objectives (MOs), and interim milestones (IMs).
- **Section 5.0 – Monitoring Network** describes the initial monitoring network established and monitored during development of the GSP, recommendations for monitoring network modifications following plan implementation to improve data coverage in data gap areas, assess sustainability criteria, and evaluate impacts from proposed projects and management actions, and outlines monitoring protocols and field sampling procedures.
- **Section 6.0 – Projects and Management Actions** provides a framework to achieve the sustainability goal for the USLR Valley Groundwater Subbasin by listing potential management actions and/or projects that may be utilized to ensure long-term sustainability, mitigate potential undesirable results, and potentially increase sustainable yield of the subbasin through additional or supplemental recharge.
- **Section 7.0 – Plan Implementation** describes the GSP implementation process, including estimated costs, sources of funding, a preliminary schedule, methodology for annual and five-year reporting, and how progress evaluations will be made over time.

1.3 Agency Information (§354.6)

1.3.1 Mailing Address (§354.6(a))

Pauma Valley Groundwater Sustainability Agency
P.O. Box 177
Pauma Valley CA 92061-0177

1.3.2 Organization and Management Structure (§354.6(b), (c))

The PVGSA formed under a Memorandum of Understanding (MOU) for the Development of a Groundwater Sustainability Plan for the San Luis Rey Valley Groundwater Basin, dated June 27, 2017. Several amendments to this MOU have been made effective since, establishing the current GSA consisting of:

- Yuima Municipal Water District (YMWD)
- Pauma Municipal Water District (Pauma MWD)
- Pauma Valley Community Services District (Pauma Valley CSD)
- San Luis Rey Municipal Water District (SLRMWD)
- Upper San Luis Rey Resource Conservation District (USLRRCD)

Contact: Amy Reeh, PVGSA
Address: P.O. Box 177, Pauma Valley CA 92061-0177
Phone: 760-742-3704
Email: amy@yuimamwd.com

A copy of the MOU and subsequent amendments for the development of the PVGSA are available on the YMWD website: https://www.yuimamwd.com/newdev/65-services/143-gsp

An Executive Team was created in the 2017 MOU to work on and manage the GSP development, which consisted of two voting members appointed by each Party with the authority from the appointing agency's Governing Body to act on behalf of that agency. Additional agencies, entities and/or individuals with specific knowledge about SGMA or groundwater management, and public agencies and/or governmental agencies with jurisdiction that overlie the USLR Subbasin were also invited to participate in Executive Team meetings. The San Luis Rey Indian Water Authority, Pauma Municipal Water District, Valley Center Municipal Water District, and Rainbow Municipal Water District were also invited to participate in the Executive Team as ex officio Members. Additional information regarding the decision-making process is provided in Section 2.5.1.

1.3.3 Legal Authority of the GSA (§354.6(d))

Parties of the PVGSA have each declared to be a GSA per Section 10723.8 of SGMA, as documented in the June 27, 2017, MOU and amendments, with the intent of collectively developing and implementing a single GSP to sustainably manage groundwater in the USLR Subbasin. These local agencies are authorized to manage groundwater per Water Code §10721(n) and SGMA throughout the USLR Valley Groundwater Subbasin other than on tribal reservation or federal lands. Members have agreed to a cost sharing methodology for initial GSP development and implementation. Additional information on costs associated with plan implementation is provided in Section 7.0.

1.3.3.1 Full Respect of Federal Reserved Water Rights (FRWRs)

The PVGSA and its members agree that federally reserved water rights (FRWRs) must be respected in full under SGMA. The federally recognized tribes within the Pauma Valley watershed assert that they possess FRWRs held in trust by the United States, including to unquantified amounts of groundwater appurtenant to their respective reservations. The PVGSA is committed to accommodating, to the extent permitted by law, the current or future exercise of any adjudicated FRWRs for use on tribal reservation lands.

2.0 Plan Area (§354.8)

The Plan Area section describes the geographic setting of the USLR Valley Groundwater Subbasin, existing water resources planning and programs, the relationship of the GSP to other general-plan documents within the basin area, and additional GSP components such as land use plans, well and project permitting processes, control of saline water, and current groundwater projects.

2.1 General Setting and Jurisdictional Area (§354.8(a),(b))

San Luis Rey Valley Groundwater Basin, located in San Diego County, extends from the confluence of the San Luis Rey River and Paradise Creek, continuing downstream through four valleys (Pauma, Pala, Bonsall, and Mission) and ending at the Pacific Ocean in the City of Oceanside (Figure 2-1). The Plan Area represents the USLR Valley Groundwater Subbasin and encompasses approximately 19,200 acres in the eastern section of San Luis Rey Valley Groundwater Basin (Figure 2-2). It is classified as subbasin 9-007.01 by the California Department of Water Resources' (DWR) Bulletin 118 (DWR, 2016). The groundwater subbasin boundaries were updated in 2018 (to be published in the 2020 5-year update of Bulletin 118) as part of the basin modification process provided for under SGMA[1]. Assembly Bill No. 1944, Chapter 255 (AB 1944, 2018), an act to amend Section 10721 of and to add Section 10722.5 to the Water Code, defines the boundary that divides the Upper and Lower San Luis Rey Valley Groundwater Subbasins. Under SGMA, the USLR Valley Groundwater Subbasin was designated a medium priority basin.

The USLR Valley Groundwater Subbasin can be further subdivided into two subbasins: the Pauma Subbasin and the Pala Subbasin. The Pauma Subbasin extends from the confluence of the San Luis Rey River and Paradise Creek to the Agua Tibia Narrows near the confluence of the San Luis Rey River and Frey Creek. The Pala Subbasin extends from the Agua Tibia Narrows to Monserate Narrows. Based on prior decisions by the State of California, groundwater in Pala Subbasin, located downstream of Frey Creek, has been determined to be a subterranean stream flowing through known and definite channels (SWRCB, 2002).

SGMA specifically excludes subterranean streams from its requirements. However, while subterranean streams are generally excluded from SGMA, Assembly Bill 1944 was put forth to include the area of the subbasin downstream from Frey Creek (i.e., Pala Subbasin) as part of SGMA for the purposes of groundwater sustainability management, notwithstanding the State Water Board's prior characterization of the Pala Subbasin as surface water flowing within relatively permanent bed and banks. AB 1944 does not alter any existing water right. Therefore, the GSP components address both the Pauma and Pala

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[1] During the course of developing this GSP, it has been determined that the current (2018/2019) basin boundaries do not appear to adequately represent the true extent of the USLR Groundwater Subbasin; areas of connected alluvial material are left outside basin boundaries in parts of the basin while other locations currently characterized as part of the subbasin are contained in foothill areas of surrounding hard rock and bedrock areas that are thinly covered by surface alluvium and otherwise appear to be hydrologically disconnected from the main subbasin alluvial aquifer system(s). This is discussed in greater detail in Section 3.0 (Basin Setting) and recommendations are provided for a future basin modification request in 2022.

Subbasins. Section 3.0 (Basin Setting) describes the hydrogeologic setting of the USLR Valley Groundwater subbasin along with its hydrologic connection between adjacent basins.

Figure 2-3 shows jurisdictional boundaries of water agencies overlying the USLR Valley Groundwater Subbasin. Within many of these service areas are parcels of land that rely on private wells for water supply. Water agencies serving areas overlying the Plan Area include (LAFCO, 2021):

- Pauma MWD
- Pauma Valley Mutual Water Company (MWC)
- Peppercorn MWC
- Rainbow MWD
- San Luis Rey MWD
- Valley Center MWD
- Yuima Municipal Water District (YMWD)

The San Diego County Water Authority (Water Authority) is also present within the Plan Area but is not actively serving areas overlying the Plan Area. However, it does provide wholesale imported water. In addition, Mootamia MWD, located within the Pauma Valley MWC boundaries, serves to protect groundwater rights.

YMWD encompasses the following MWCs and community services districts (CSDs):

- Mutual Water Companies
    - Rancho Pauma MWC
    - Rancho Estates MWC
    - Lazy H MWC
    - Pauma Ridge Mutual
    - Rincon Oaks Water Service
    - Three Party Water Company
- Community Services Districts
    - Rincon Ranch Road CSD
    - Pauma Valley CSD

Also present within the Plan Area are several Sovereign Tribal Nations that have autonomy over their lands, follow Federal environmental laws and regulations (RWMG, 2018). The Tribes provide domestic and irrigation water for their various enterprises, including casino and agricultural operations, and monitor water resources on their respective reservations. The GSA has limited water production and other information regarding Tribal water use. Tribal lands are shown on Figure 2-4, denoted by the Bureau of Indian Affairs Land Area Representations (LARs), and include:

- La Jolla Band of Luiseno Mission Indians
- Rincon Band of Luiseno Mission Indians
- Pauma Band of Luiseno Mission Indians
- Pala Band of Luiseno Mission Indians

California protected areas within the Plan Area, also shown on Figure 2-4, include (CCED, 2020; CPAD, 2020):

- Wilderness Gardens Preserve (County of San Diego)
- Granger Preserve (Fallbrook Land Conservancy)
- Plaisted Creek Ecological Reserve (California Department of Fish and Wildlife)
- Cleveland National Forest (United States Forest Service)
- YMWD no public access Open Space
- Tierra Miguel Conservation Easement (Tierra Miguel Foundation, United States Natural Resources Conservation Service)
- California Desert Conservation Area (California Desert District, United States Bureau of Land Management).

The Wilderness Gardens Preserve, acquired in 1973, is the oldest San Diego County Parks and Recreation open space preserve (SDPARKS, 2020). The private, nonprofit Fallbrook Land Conservancy was founded in 1988 and protects both conservation easements and open space preserves, including the Granger Preserve (CCLT, 2020). The Plaisted Creek Ecological Reserve is state owned and managed by the California Department of Fish and Wildlife (SDMMP, 2020). The Cleveland National Forest is the southern-most National Forest in California and is managed by the United States Forest Service (USFS, 2020).

2.1.1 General Land Use Characteristics

2017 land use within the Plan Area was obtained from Southern California Association of Governments based on San Diego Association of Governments (SANDAG) mapping (SCAG, 2019) and is shown on Figure 2-5. This 2017 land use is used to illustrate existing land use conditions as it is the most recent SCAG publication available (SCAG updates occur approximately every five years). Land use within Pauma Subbasin is approximately 52% irrigated agriculture/ parks/ golf, 27% open space/ water, 17% residential, and 4% commercial/ industrial/ public facilities. In Pala Subbasin, land use is approximately 42% open space/ water, 38% irrigated agriculture/ parks, 12% residential, and 8% commercial/ industrial/ public facilities.

According to the DWR Disadvantaged Communities (DAC) Mapping Tool, which relies on U.S. Census data published by American Community Survey, a portion of a severely disadvantaged community (SDAC) block group has been identified in the basin area (see Figure 2-6). This SDAC includes a population of 1,448 in 443 households, for which median household income is approximately $42,357. As shown on Figure 2-6, the SDAC area is located in alluvial fan area in the northeast section of the subbasin, in both Pala and Pauma Subbasins. Letters were sent to all parcels in this area as part of the GSP outreach effort (see Section 2.5 for additional discussion), and large portions of this area were included in basin monitoring. However, there are areas within the SDAC block group that have been identified as data gap areas (see Section 5.3). Additional information will need to be collected in data gap areas to fully understand and characterize basin conditions and ensure that sustainable management criteria are protective of users in these areas (see Section 4.0).

2.1.2 Water Source Types and Water Use Sectors

Creating sustainable groundwater management in the USLR Valley Groundwater Subbasin requires the efficient use of all the available water source types utilized by the Plan Area. There are three primary water source types: groundwater, surface water, and imported water. In the YMWD service area, 91% of the water provided is used for agricultural purposes, 2% for residential, and 7% is wholesale.

An overview of the three primary water source types is provided below. Section 3.0 (Basin Setting) further describes water uses in relation to the USLR Valley Groundwater Subbasin water budget.

2.1.2.1 Groundwater

Groundwater in the USLR Valley Groundwater Subbasin is found within the alluvial-filled valley areas (i.e., Pauma and Pala Valleys). The valleys are separated by narrow, steep walled canyons and are underlain by alluvial fill of varying thickness. Pauma Valley is approximately 7.5 miles long and varies in width from approximately one mile to 2.25 miles. The alluvial fill in Pauma Valley comprises river channel deposits and younger alluvium (0 to 130 ft thick), alluvial fan deposits (up to 370 ft), and older alluvium (maximum thickness of 160 ft) (SWRCB, 2002). Pala Valley is bounded by the same basement complex as the Pauma Basin. However, the alluvial fill is not as thick as Pauma Valley and is comprised of river channel deposits and younger alluvium, and alluvial fan deposits.

In 2002, the State Water Resources Control Board (SWRCB) determined that water within Pauma Subbasin, while hydraulically connected to the San Luis Rey River, is percolating groundwater and not part of the river flow as it filters through the ground (Decision 1645). Through the same SWRCB Decision 1645, Pala Subbasin was found to be confined subterranean San Luis Rey River streamflow through known and defined channels. However, for the purposes of SGMA, the technical assessment of groundwater conditions and evaluation of the appropriate management strategies will be applied to the Pala Subbasin with understanding that the GSP has no authority over water rights there.

Outside of the more productive alluvial aquifers, groundwater is produced from fractured crystalline bedrock and semi-consolidated sedimentary deposits that bound and underlie the alluvium. However, yield and storage in these aquifers are limited, and the aquifers are best suited for meeting domestic water needs that do not require higher flow rates. Groundwater is produced in the Plan Area for use within and outside of the basin and provides an important source of water to meet water demands. In addition to the water agencies listed in the previous section, private groundwater producers also pump groundwater for irrigation, agricultural needs, and other uses.

Groundwater well density within the basin (based on DWR reported wells per section) is shown on Figure 2-7. As shown, the highest density of wells is generally found along the axis of the subbasin, parallel to the San Luis Rey River. According to available well information from DWR, the average domestic well depth in Pala Subbasin is approximately 140 ft. Agricultural production wells in Pala average approximately 240 ft in depth while municipal/public supply wells average approximately 200 ft in depth. In Pauma Subbasin, wells tend to be slightly deeper, with average domestic, agricultural production, and municipal/public supply wells averaging approximately 250 ft, 350 ft, and 370 ft in depth, respectively. However, as discussed in the Basin Setting section, well information is somewhat limited. The DWR database this well density and depth information comes from is incomplete and contains data for older wells which may be abandoned. Other well databases also have incomplete records. Therefore, addressing data gaps associated with well locations, construction information (e.g., well depth, screened intervals, etc.), water level conditions, and pumping will be a key area of focus following implementation of the GSP. Additional discussion is provided in Section 5.3 and 6.2.2.

2.1.2.2 Surface Water

Upstream of the USLR Valley Groundwater Subbasin lies Henshaw Dam, which controls flow in the San Luis Rey River and has created the reservoir Lake Henshaw. The dam was built in 1923 and is owned and operated by Vista Irrigation District (VID). Water from Lake Henshaw is transported to VID and City of Escondido service areas via the Escondido Canal. The Rincon Band of Luiseno Indians purchases raw water from Escondido and VID, which is also delivered through the Escondido Canal.

Improvement District "A", managed by YMWD, used to operate a catch basin (Yuima Creek) into Dunlap Reservoir and Pettis Reservoir. This catch basin has been destroyed. A second catch (Nate Harrison Canyon) was operated for a number of years into Hegardt Reservoir. However, as the result of overgrowth hampering access, new surface treatment rules, and limited funds and personnel, the basin fell into disrepair. Rapidly rising power and water costs and a fire in 1987 that cleared the area for better access made it feasible for YMWD to make necessary repairs to reactivate this catch and maintenance road. In 2017, an agreement was entered into to refurbish, maintain, and operate the catch system for 20 years, thus effectively exercising riparian rights to creek while separating it from the potable system. Several other entities within the USLR Valley Groundwater Subbasin also hold active surface water diversion rights, which are available to view on the Electronic Water Rights Information Management System (eWRIMS)[2].

2.1.2.3 Imported Water

Several large water agencies within the larger San Luis Rey River Watershed (e.g., Valley Center MWD, Rainbow MWD, and Fallbrook Public Utilities District) are virtually 100% reliant on the availability of imported water (SDIRWM, 2019). Within the USLR Valley Groundwater Subbasin, YMWD receives imported water through Metropolitan Water District of Southern California (Metropolitan) and the San Diego County Water Authority (Water Authority). Additionally, as discussed in Section 2.2.3, the SLRIWA has the ability and authority (though not the obligation) to import 16,000 AFY into the Plan Area, above and beyond the supplies of imported water already provided via the Water Authority and Metropolitan Facilities.

2.1.2.3.1 Metropolitan Facilities

Colorado River supplies are transported from Lake Havasu through the Colorado River Aqueduct to Diamond Valley Lake and then to Lake Mathews in Riverside County. Before reaching Lake Mathews, a portion of the water is delivered through the San Diego Canal to Lake Skinner (the major storage facility for San Diego), where it is treated.

[2] Diversion information available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/

State Water Project (SWP) supplies are delivered to Lake Perris, which is the terminus of the 444-mile California Aqueduct. It is then blended with Colorado River water in the San Diego Canal where it flows into Lake Skinner. Metropolitan delivers a blend of Colorado River water and SWP water. The percentage derived from each of the two sources varies from year to year, depending on hydrologic, environmental, and political factors. The Metropolitan Act provides a preferential right for the purchase of water by each of its constituent agencies. The preferential right is calculated using a formula.

2.1.2.3.2 Water Authority Facilities

The Water Authority was organized on June 9, 1944, under the County Water Authority Act. The Water Authority's primary purpose is providing wholesale water to its member agencies for domestic, municipal, and agricultural uses. The Water Authority consists of 24 public agency members that are each represented by at least one person the Water Authority's Board of Directors. The Water Authority is also a member of Metropolitan. Historically, the Water Authority purchased all the water it required from Metropolitan to meet the demand of the member agencies. The Water Authority has been in the process of diversifying its supply. Pursuant to the Quantification Settlement Agreement signed October 2003, and its related contracts, the Water Authority obtains conserved water from the Imperial Irrigation District (IID) and will also receive water conserved by the lining of the All-American and Coachella Canals.

Water Authority takes delivery of water from Metropolitan through five primary pipelines buried in two rights-of-way called the San Diego Aqueducts. The delivery points are located about six miles south of the Riverside-San Diego County line. From there, water is distributed through more than 279 miles of pipeline to Water Authority's 24 member agencies through 119 service connections to serve 2.7 million residents in San Diego County (Water Authority, 2008).

2.1.2.3.3 Yuima Connection

YMWD is served off the First Aqueduct, Pipeline No. 1, near Couser Canyon Road in Valley Center just north of Lilac Tunnel and receives treated water from Lake Skinner. Delivery requests are made twice daily to the Water Authority based on estimated demands in excess of local water delivery ability. Because these connections can access only treated water supplies from the Skinner Treatment Plant, YMWD's total access to imported water is affected by the capacity limitations of Skinner, which has operated recently at or near its design capacity. Prior to the expansion of the Skinner Filtration Plant in 1991, YMWD also received raw Colorado River water.

2.2 Water Resources Monitoring and Management Programs (§354.8(c),(d),(e))

2.2.1 Existing Monitoring Programs and Networks

Existing monitoring programs and networks in the Plan Area measure and record a variety of data used to understand the USLR Valley Subbasin and study natural and anthropogenic effects on the aquifer system. While local districts have generally maintained records within their individual service areas, there is currently no unified monitoring plan in the Pauma/ Pala Subbasins. This GSP recommends a unified monitoring program to provide accurate and needed information regarding regional groundwater conditions throughout the two subbasins (Section 5.0, Monitoring Network). In addition, future involvement of the local Tribal entities may allow the beneficial incorporation of additional monitoring locations and basin coverage. This section provides a description of the existing monitoring programs and networks utilized in the Plan Area.

2.2.1.1 Groundwater Monitoring

Within the Plan Area, groundwater levels, groundwater production, and groundwater quality are currently monitored. There is currently no active subsidence monitoring program due to the absence of past instances of subsidence induced damage. Given the geologic and hydrogeologic conditions that exist in the area, it is unlikely that subsidence will occur in the USLR Valley Subbasin. The geologic and hydrogeologic conditions are described in Section 3.0 (Basin Setting).

2.2.1.1.1 Groundwater Level Monitoring

Continuous groundwater level monitoring occurs within the Plan Area to comply with the 2009 California Senate Bill X7-6 that requires statewide groundwater elevations, collected through collaboration between local monitoring parties and the DWR, be made available to the public (Geosyntec, 2015). In response to the law, DWR developed the California Statewide Groundwater Elevation Monitoring (CASGEM) Program in 2009 to establish a permanent, locally managed program of routine groundwater monitoring to track seasonal and long-term groundwater elevation trends in all of California's alluvial groundwater basins (Geosyntec, 2015). San Diego County is the sole Monitoring Entity for the Plan Area having volunteered to provide groundwater data to CASGEM (Geosyntec, 2015). The County currently reports data from four wells in the Pauma/Pala Subbasins.

2.2.1.1.2 Groundwater Production Monitoring

There is currently no requirement to submit annual groundwater production to the State. However, Urban Water Management Plans (UWMPs) must be prepared by urban water suppliers every five years if the supplier either provides over 3,000 acre-ft of water annually or serves more than 3,000 urban connections (DWR, 2021). Each UWMP assesses water resource reliability over a 20-year planning time frame, explains demand management measures and water shortage contingency plans, describes the use and planned use of recycled water, and reports the progress towards the 2020 year targeted 20 percent reduction in per-capita urban water consumption (DWR, 2021). DWR provides guidance for urban water supplies, reviews submitted plans, and summarizes the status of the plans for each five-year cycle to report to Legislature. Within the USLR Valley Groundwater Subbasin, YMWD is a member of the Water Authority, which has established an Integrated Regional Water Management Plan for the greater San Diego region. This plan is discussed in Section 2.2.2.2. The PVGSA has requested groundwater level monitoring data and pumping data from the SLRIWA, but no data have been received to date. PVGSA will continue to outreach to SLRIWA and its tribal members in furtherance of refining and improving the existing data in the subbasin and associated models. Adding this additional groundwater monitoring and level data, should SLRIWA be willing to cooperate in data sharing on or around tribal lands, will enhance the ability of PVGSA to manage the entire subbasin while avoiding taking actions/engaging in omissions that fail to fully respect FRWR.

2.2.1.1.3 Groundwater Quality Monitoring

Groundwater quality within the Plan Area is continuously monitored to meet the California Department of Public Health's (CDPH's) requirements specified in Title 22 of the California Code of Regulations (CCR). All active municipal production wells must comply with CDPH's requirements. Groundwater quality data are collected through many different programs at the state and national levels. An evaluation of data from the groundwater quality monitoring programs described below is provided in Section 3.0 (Basin Setting). Furthermore, groundwater monitoring proposed in Section 5.0 (Monitoring Network) will provide additional data for ongoing assessment of local basin conditions.

California Department of Toxic Substances Control (DTSC)

In addition to poor ambient water quality, contamination from point sources can also introduce and spread contaminates within an aquifer system. The DTSC protects California's people and environment from toxic substances through the restoration of contaminated resources, enforcement of hazardous waste laws, reduction of hazardous waste generation, and encouragement to manufacture chemically safer products. The Envirostor database provides cleanup tracking, access to permitting, and enforcement and investigation efforts. Based on a search of DTSC's Envirostor database, there are currently no sites requiring action that could potentially affect the Plan Area aquifer system.

Safe Drinking Water Information System (SDWIS)

The Safe Drinking Water Act requires states to report drinking water information to the Environmental Protection Agency (EPA). The EPA works to protect human health and the environment at the Federal level. Data provided to the EPA through the Safe Drinking Water Information System (SDWIS) are maintained in a Federal database known as the SDWIS Fed Data Warehouse and are searchable.

State Water Resources Control Board (SWRCB)

The SWRCB maintains several online databases related to water quality.

GeoTracker is an online database that identifies known contamination cleanup sites, leaky underground storage tanks, and permitted facilities such as irrigated lands, oil and gas production, operating permitted underground storage tanks, and land disposal sites.

The Groundwater Ambient Monitoring and Assessment (GAMA) Program is California's comprehensive groundwater quality monitoring program created by the SWRCB in 2000 and expanded by the Groundwater Quality Monitoring Act of 2001. Public access to groundwater quality data from various sources is provided through GeoTracker GAMA on an interactive Google-based map.

2.2.1.2 Subsidence Monitoring

There is currently no active subsidence monitoring program in the Plan Area. There are no measurements of historical subsidence available and no instances of subsidence induced damage identified. Land subsidence monitoring will likely not be considered in the future due the nature of the aquifer systems in the subbasin (see Section 3.3.4.7 for more information).

2.2.1.3 Surface Water Monitoring

The United States Geological Survey (USGS) has several gaging stations in the USLR Valley Groundwater Subbasin to monitor streamflow in the San Luis Rey River and main tributaries. Streamflow data are available through the National Water Information System (NWIS)[3]. However, many of the gages in the subbasin are inactive and have limited data.

Water diversions from surface water are also recorded by diversion rights users and reported in annual reports available through eWRIMS.

2.2.1.4 Climate Monitoring

Weather monitoring stations provide a range of invaluable data, including the precipitation data used to determine a Subbasin water budget. A strategic plan for future water supply needs and steps to prepare for drought conditions can be created with an accurate water budget.

The primary weather station used to calculate mean annual rainfall for the San Luis Rey Valley Subbasin is National Oceanic and Atmospheric Administration (NOAA) Station at Henshaw Dam. The Henshaw Dam Station is southeast of the Plan Area, near Lake Henshaw. Daily precipitation and air temperature data is collects at this station. The data record for the Henshaw Dam Station extends as far back as 1941 and continues to the present day. Supplemental precipitation data are available from two YMWD gaging stations and two sources of private records, provided to aid the development of this GSP. 30-year normal precipitation contours are also available through the PRISM Climate Group, which gathers climate observations from a wide range of monitoring networks, applies sophisticated quality control measures, and develops spatial climate datasets to reveal short- and long-term climate patterns.

2.2.2 Existing Management Programs and Studies

Regulatory guidelines, planning recommendations, and other existing documents are currently used to broadly manage Plan Area groundwater and the groundwater surrounding the USLR Valley Subbasin. These management programs and studies have been developed by multiple agencies and organizations for a variety of purposes, but none of them have been specifically developed for the USLR Valley Subbasin. This section summarizes the most relevant groundwater management programs and studies in the USLR Valley Subbasin Plan Area.

2.2.2.1 San Diego County Groundwater Ordinance

The San Diego County Groundwater Ordinance[4] provides regulations for the protection, preservation, and maintenance of groundwater resources in San Diego County. This includes reviewing land development applications and evaluating additional groundwater demand. Developments in “Groundwater Impacted Basins” (identified by low yielding wells, developments in excess of available water sources, and/or declining water levels) require a groundwater investigation indicating that groundwater resources are sufficient to meet groundwater demands of the project. In addition, any project that proposes the use of groundwater not provided by a Water Service Agency may be subject to residential density controls, groundwater investigations, and well tests. Guidelines for determining the significance of adverse

[3] https://waterdata.usgs.gov/ca/nwis/rt
[4] https://www.sandiegocounty.gov/dplu/docs/GROUNDWATER-ORD.pdf

environmental effects a proposed project may have on groundwater resources are also provided by the County[5], which are consistent with California Environmental Quality Act (CEQA) guidelines.

2.2.2.2 Water Quality Control Plan for the San Diego Basin

The 1994 Water Quality Control Plan for the San Diego Basin (Basin Plan) was developed by the California Regional Water Quality Control Board, San Diego Region (Regional Board) and adopted by the Regional Board on September 8, 1994. The Basin Plan was created to protect, preserve, and enhance, where possible, the quality of waters within the San Diego Region. It is a dynamic document and subject to modification based on changing needs and circumstances with changes considered at a minimum of every three years (Regional Board, 1994). The Basin Plan is divided into chapters reviewing and designating beneficial uses, water quality objectives, implementation, plans and policies, surveillance, monitoring and assessment, and total maximum daily loads. The Basin Plan functions to:

- Designate beneficial surface and groundwater uses in the Region
- Designate narrative and numerical water quality objectives for the reasonable protection of the defined uses
- Establish an implementation plan to protect the beneficial uses of the Region waters
- Describe the monitoring activities used to evaluate the effectiveness of the Basin Plan

The five policy statements listed below form the Regional Board's Water Quality Management Policy for the San Diego Region (Regional Board, 1994):

- An integral part of water quality management includes the water quality objectives, beneficial uses, and water quality control plans and policies adopted by the SWRCB and the Regional Board.
- Water reclamation and reuse shall be executed to the maximum extent feasible.
- Pollution point sources and nonpoint sources shall be controlled to protect designated beneficial uses of water.
- Instream beneficial uses shall be maintained and when practical, restored, and enhanced.
- Throughout the Region, a detailed and comprehensive knowledge of the beneficial uses, water quality, and activities affecting water quality shall be maintained.

2.2.2.3 San Diego Integrated Regional Water Management Plan

The 2007 San Diego Integrated Regional Water Management Plan established a regional program for protecting, managing, and developing reliable and sustainable water resources in accordance with statewide Integrated Regional Water Management (IRWM) Program Guidelines. IRWM Program Guidelines were first established in 2004 by the SWRCB and DWR and later updated in 2007. The 2007 San Diego IRWM Plan was published under the direction of the Regional Water Management Group (RWMG), comprised of the San Diego County Water Authority, the City of San Diego, and the County of San Diego, and with the assistance of the Regional Advisory Committee (RAC). Formed in December 2006,

[5] https://www.sandiegocounty.gov/dplu/docs/GRWTR-Guidelines.pdf, https://www.sandiegocounty.gov/content/dam/sdc/pds/ProjectPlanning/docs/GRWTR-Report-Format.pdf

the RAC is composed of experts to represent disadvantaged communities, regulatory agencies, water suppliers, wastewater agencies, water quality interests, environmental groups, academic institutions, business, and agriculture.

Four Plan goals were developed through a public outreach process by the RWMG and regional stakeholders and outlined in the 2007 San Diego IRWM Plan. The four goals were to 1) optimize water supply reliability, 2) protect and enhance water quality, 3) provide stewardship of natural resources, and 4) coordinate and integrate water resource management. Nine objectives were developed by the RWMG, RAC, and regional stakeholders to accomplish the IRWM Plan goals and measurable targets for each objective were determined. The objectives included:

- Objective A: Maximize stakeholder/community involvement and stewardship
- Objective B: Effectively obtain, manage, and assess water resource data and information
- Objective C: Further scientific and technical foundation of water management
- Objective D: Develop and maintain a diverse mix of water resources
- Objective E: Construct, operate, and maintain a reliable infrastructure system
- Objective F: Reduce the negative effects on waterways and watershed health caused by hydromodification and flooding
- Objective G: Effectively reduce sources of pollutants and environmental stressors
- Objective H: Protect, restore, and maintain habitat and open space
- Objective I: Optimize water-based recreational opportunities

Thirty water management strategies were selected and included in the IRWM Plan to address water resource issues involving water supply conservation, water quality protection, land conservation, runoff management, habitat and ecosystem enhancement, flood management, and recreation (RWMG, 2007). A two-stage prioritization process of Plan-level and Funding-level prioritization was proposed to evaluate the more than 160 water management projects considered and narrow the list before submission of grant applications. Project benefits and impacts monitoring, data management, conformance with Statewide priorities and consistency with local plans, and stakeholder involvement were also important components of the San Diego IRWM Plan.

The San Diego IRWM Plan was updated in 2013 and 2019. The 2013 San Diego IRWM Plan was revised to comply with the DWR’s 2016 IRWM Program Guidelines and updated with new water planning studies (SDIRWM, 2020). Both the 2013 and 2019 IRWM Plans provide 1) regional coordination and integration of existing planning efforts, 2) determination of regional and watershed-based priorities for implementation projects, and 3) support for funding plans, programs, projects, and priorities of existing agencies and stakeholders (RWMG, 2013 and 2018). The 2019 update has also allowed regional stakeholders to review and adjust Plan goals, objectives, and priorities (RWMG, 2018). The RWMG currently meets bi-weekly and is responsible for the administration and implementation of the San Diego IRWM Program. The RAC meets bi-monthly and assists with IRWM planning and funding applications (SDIRWM, 2020).

2.2.2.4 San Diego Regional Agricultural Water Management Plan

In 2016, the San Diego Regional Agricultural Water Management Plan (RAWMP) was prepared by the San Diego County Farm Bureau (SDCFB) and fourteen participating retail water agencies that serve commercial agricultural customers in the northern half of San Diego County (Weinberg and Jacoby, 2016a). The SDCFB is a non-profit membership organization founded in 1914 and works to promote and protect agriculture. The RAWMP describes and documents the San Diego Region's existing and proposed water management programs and activities that affect water use efficiency of the fourteen retail water agencies while complying with requirements of the SWRCB May 15, 2015 Emergency Regulation for Statewide Urban Water Conservation (Weinberg and Jacoby, 2016a). Compliance with the 2015 Emergency Regulation allows urban water supplies to deduct commercial agricultural deliveries from their agency's conservation target.

The San Diego RAWMP was prepared in accordance with the Water Conservation Act of 2009 (SBx7-7), which modified Division 6 of the California Water Code by adding Part 2.55 (commencing with §10608) and replacing Part 2.8 (commencing with §10800) (Weinberg and Jacoby, 2016a). The RAWMP consists of two parts. Part I addresses the Plan requirements from a regional perspective, utilizing regional planning documents such as: the SDCWA's 2010 Urban Water Management Plans (UWMP), the San Diego 2013 Integrated Regional Water Management Plan, and County of San Diego General Plan documents (Weinberg and Jacoby, 2016a). It also breaks down regional planning to sections including:

- Water Management Facilities
- Terrain and Soils
- Climate
- Operational Characteristics
- Regional Water Shortage Allocation Policies
- Water Use
- Water Supplies and Hydrology
- Water Quality
- Climate Change
- Water Use Efficiency Information

Part II of the San Diego RAWMP provides agency-specific information on Agriculture Water Management Plan requirements for the fourteen water suppliers by refencing 2010 UWMPs and Water and Waste Water Master Plans (Weinberg and Jacoby, 2016b). Each agricultural water supplier possesses its own operating rules and regulations as well as associated policies, which are detailed in Part II. A total of 380,000 acres are serviced by the fourteen participating agencies (including YMWD within the USLR Valley Groundwater Subbasin), of which 44,210 acres are irrigated agricultural lands (Weinberg and Jacoby, 2016a). Part II is organized with the two largest agricultural water suppliers listed first and then alphabetical order for the remaining water supplies.

The fourteen retail water suppliers include:

- Carlsbad Municipal Water District
- City of Escondido

- City of Oceanside
- City of Poway
- Fallbrook Public Utilities District (PUD)
- Olivenhain MWD
- Rainbow MWD
- Ramona MWD
- Rincon del Diablo MWD
- San Dieguito Water District
- Santa Fe Irrigation District
- Vallecitos Water District
- Valley Center MWD
- YMWD

2.2.3 Legal Decisions

2.2.3.1 Stipulated Judgment: Strub et al. v. Palomar Mutual Water Company

Prior to YMWD's formation in 1963, Pauma Valley's sole source of water was groundwater. Following a period of drought extending back to 1949, coupled with increased agricultural water demands, the water table fell and overdrafts of the underlying Pauma Subbasin lowered groundwater levels as much as 85 feet, forcing the abandonment of some wells and giving rise to increased pumping costs.

The drought also led to a stipulated judgment in the case of *Strub et al. v. Palomar Mutual Water Company* (Palomar MWC) (Superior Court of CA, 1953). This judgment limited Palomar MWC to withdrawal of no more than 1,350 acre-ft/yr from wells in the Pauma Subbasin (below 1,000 ft above mean sea level (amsl) and upstream of Cole Grade Road) for use on the lands it served. After annexing Palomar MWC in 1964, YMWD became successor in interest to Palomar MWC and continues to operate the former Palomar MWC system and properties (now known as Improvement District "A" [IDA]) as an independent water system (California State System No. 3700938). YMWD is responsible for administering IDA's compliance with Strub et al.

2.2.3.2 San Luis Rey Indian Water Rights Settlement Act

The following information is from the SLRIWA website[6]. According to the SLRIWA, the United States, City of Escondido, Escondido MWC, VID, and the La Jolla, Rincon, San Pasqual, Pauma and Pala Bands of Mission Indians entered into a settlement agreement in 1988 once the need to provide the tribes with supplemental water supply was recognized. U.S. Congress passed the San Luis Rey Indian Water Rights Settlement Act to settle FRWR claims of the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Mission Indians in San Diego County, California, to authorize the lining of the All-American Canal, and for other purposes. The Settlement Act provided the following for the Indian Bands:

- Authorization for Indian Bands to enter into settlement agreements.

6 https://www.slriwa.org/documents/statement-for-san-luis-rey-indian-water-authority

- A federal trust fund of $30 million was created for settlement implementation.
- Supplemental water of 16,000 acre-ft/year for use by the settlement parties to be arranged by the Secretary of the Interior.

The supplemental water source is a portion of the water savings produced by projects lining sections of two large earthen canals that convey water from the Colorado River to the Imperial and Coachella Valleys in Southern California. Three additional agreements were needed to make the Colorado River water available for the San Luis Rey settlement. The three agreements were signed by the United States, the La Jolla, Rincon, San Pasqual, Pauma, and Pala Bands of Mission Indians, and other essential parties in 2003 and consist of:

- Allocation Agreement — the allocation of water saved by the lining of the All-American and Coachella Canals will be divided as follows:
    - The first 16,000 acre-ft will be received by the San Luis Rey Settlement Parties annually,
    - The remaining saved water, approximately 77,000 acre-ft/year, is allocated to the San Diego County Water Authority.
- Water Delivery Agreement — Transfer of the conserved Colorado River water from Lake Havasu, located on the border between California and Arizona, to northern San Diego County will be completed by Metropolitan.
- Water Conveyance Agreement — Transfer of the settlement water from northern San Diego County to the San Luis Rey Settlement Parties will be completed by the Water Authority. The Indian Bands may sell any water not needed to Escondido and the VID.

The San Luis Rey Indian Water Authority (SLRIWA) was created by the La Jolla, Pala, Pauma, Rincon, and San Pasqual Bands of Mission Indians to ensure their input in the water use and supply of the San Luis Rey River Basin (SLRIWA, 2020). According to the SLRIWA website, no settlement water has yet been delivered.

2.3 General Plan and Related Land Use Planning (§354.8(f))

2.3.1 General Plan

The Pala and Pauma Subbasins are part of the County of San Diego's General Plan (County of San Diego, 2015). Planned land use was available through SANDAG (2018; see Figure 2-8). SANDAG's planned land use and zoning data was developed to provide regional growth forecasts to be used as a planning tool. Existing SANDAG land use data (see Section 2.1.1) were used as the foundation for building the planned land use data. However, the land use codes for current and planned land use are different. For example, the "agriculture" classification for current land use is represented by the more general zoning code "rural residential". The County does not have land use authority for tribal reservations and any land under state or federal jurisdiction. These areas are classified by the County as "no jurisdiction."

Future land use in the USLR Valley Groundwater Subbasin is anticipated to remain predominantly agricultural. Previous estimates of population growth in the Pauma Subbasin have been on the order of 0.5% per year, or less (Weinberg and Jacoby, 2016a). Considering that only about 2.5% of total Pauma

Valley demand is residential, the increase in population growth is expected to be negligible with respect to overall water demand. Any future urban development is anticipated to predominately occur in within the area designated as the Pauma Valley Village Boundary. However, since the present Pala and Pauma Subbasins are unable to accommodate current SANDAG population forecasts through 2030, future urban development will be contingent on availability of necessary services, demonstrated need, and environmental factors (County of San Diego, 2015).

2.3.2 Future Water Demand and Supply

Groundwater management is the planned and coordinated local effort of sustaining the groundwater basin in order to meet future water supply needs. As competition for imported water supplies continues to become more intense and as drought, regulatory changes, and potential catastrophic failures threaten imported supplies, groundwater will continue to play a key role in creating a cost-effective and reliable water supply in the Plan Area.

The GSP outlines proposed projects and management actions to manage the basin through varying hydrologic conditions as well as planned extractions and recharge activities. The basin management approach outlined in this GSP will work towards avoiding undesirable results by acting to prevent:

- The chronic lowering of groundwater levels, indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon.
- Significant and unreasonable reduction of groundwater storage.
- Significant and unreasonable degraded groundwater quality.
- Depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water.

The Plan Area also functions within a regional context where growth outside of the basin impacts the total water demand and changes in supplies outside the basin impact water availability in the basin; both changes in demand and changes in supply impact the demands placed on Plan Area groundwater. Potential future projects and management actions are discussed in Section 6.0 of the GSP.

2.3.3 Well Permitting Policies and Procedures

In rural regions of San Diego County, water wells are routinely used as the only potable water supply. The San Diego County Department of Environmental Health (DEH) Land and Water Quality Division regulates and issues permits for all water well construction, destruction, and modifications, consistent with DWR regulations. Within the regulatory framework of SGMA, the GSA has no authority to permit well construction activities. Therefore, well permitting will continue to be regulated by the County.

Completed well permit applications can be emailed to Wells.DEH@sdcounty.ca.gov or dropped off in-person at 5500 Overland Ave, Suite 210, San Diego, CA 92123. Permit fees can be mailed in, brought in-person, or credit card payments may be provided over the phone for an additional processing fee.

Water well application:
https://www.sandiegocounty.gov/content/dam/sdc/deh/lwqd/Well%20App%20Complete%20Form.pdf

Instructions for paying water well permit fees online:
https://www.sandiegocounty.gov/content/dam/sdc/deh/water/docs/mwp_payment_flyer.pdf

The San Diego County DEH Monitoring Well Program issues all permits and enforces State standards and local ordinances related to the construction, modification, maintenance, and destruction of monitoring wells, inclinometers, vapor probes, cathodic protection wells, and enhanced leak detection systems (ELD).

Once the Monitoring Well Program permit is filled out with the required information, it can be emailed to MonitoringWells.DEH@sdcounty.ca.gov (preferred method), dropped off in-person at 5500 Overland Avenue, Suite 110, San Diego, CA 92123, or mailed to P.O. Box 129261, San Diego, CA 92112-9261. Permit fees can be mailed in, brought in-person, or paid online at http://www.DEHPAY.com.

Monitoring well application:
https://www.sandiegocounty.gov/content/dam/sdc/deh/water/docs/sam_monit_well_permit_appl_interactive.docx

Instructions for paying Monitoring Well Program fees online:
https://www.sandiegocounty.gov/content/dam/sdc/deh/water/docs/mwp_payment_flyer.pdf

2.4 Additional GSP Elements (§354.8(g))

2.4.1 Control of Saline Water Intrusion

Saline, or brackish, water intrusion is the induced migration of saline water into a freshwater aquifer system. The USGS defines parameters for saline water, typically measured by total dissolved solids (TDS) as follows:

- Fresh water - Less than 1,000 ppm (or mg/L)
- Slightly saline water - From 1,000 ppm to 3,000 ppm
- Moderately saline water - From 3,000 ppm to 10,000 ppm
- Highly saline water - From 10,000 ppm to 35,000 ppm

Saline water intrusion is typically observed in groundwater basins in closer proximity to the coast (e.g., downstream reaches of the Lower San Luis Rey Valley Groundwater Subbasin[7]), where lowering of groundwater levels from pumping can reverse the groundwater flow gradient and allow ocean water to flow inland to lower groundwater elevations. Given the distance of the USLR Valley Groundwater Subbasin

[7] The neighboring Lower San Luis Rey Valley Groundwater Subbasin has had historical issues with seawater intrusion (prior to the 1960s), between two to six miles inland from the Pacific Coast. Imported water deliveries have since allowed groundwater levels to recover enough to maintain groundwater gradients and limit seawater intrusion (SDIRWM, 2020). Current salinity values are still measuring high in the Lower San Luis Rey Valley Groundwater Subbasin, possibly from a combination of salt loading from storm water and irrigation flows and historical seawater intrusion effects (City of Oceanside et al., 2008). Maintaining control of saline water intrusion is requirement in the Oceanside Narrows through use of minimum threshold groundwater elevations designed to maintain a seaward groundwater gradient in the Mission Basin.

from the coast, the possibility of saltwater intrusion from the ocean is not considered an issue and will be discussed only minimally in following GSP sections.

Saline water can also generally be found at depth in alluvial groundwater basins where years of naturally occurring salts have accumulated. Pumping at shallower depths can induce the movement of higher saline water from depth up into freshwater aquifer systems. However, the USLR Valley Groundwater Subbasin is relatively narrow and shallow compared to other alluvial groundwater basins in Southern California, and highly saline water has not been found at depth.

While saline water intrusion is unlikely in the USLR Valley Groundwater Subbasin, historical agricultural use in the basin has caused some areas to exhibit elevated TDS concentrations, on the order of 1,500 mg/L to 2,500 mg/L. A discussion of this other water quality conditions in the subbasin is provided in Section 3.0 (Basin Setting) and will be addressed as appropriate as part of the sustainability goals of the GSP.

2.4.2 Wellhead Protection and Recharge Areas

The most important recharge sources in the basin are stormflow in the San Luis Rey River and its tributaries, and by imported irrigation water applied on upland areas (DWR, 2003). Ninety percent of the potable water supply for the San Diego Region comes from imported water with an additional approximately ten percent coming from local reservoirs (CRWQCB, 1994). The highest precipitation in San Diego County occurs at the higher mountainous elevations, some of which form the eastern subbasin boundary, however natural recharge in the Plan Area is limited (County of San Diego, 2010).

The Federal Wellhead Protection Program was established by Section 1428 of the Safe Drinking Water Act Amendments of 1986. The purpose of the program is to protect groundwater sources of public drinking water supplies from contamination, thereby eliminating the need for costly treatment to meet drinking water standards. DWR Bulletins 74-81 (DWR, 1981) and 74-90 (DWR, 1991) provide specifications pertaining to wellhead protection, including:

- Methods for sealing the well from intrusion of surface contaminants
- Covering or protecting the boring at the end of each day from potential sources of pollution or vandalism
- Site grading to ensure drainage is away from the wellhead

Continued protection is required to maintain high quality recharge as water wells are routinely used as the only potable water supply in rural regions of San Diego County (SDCDEH, 2020). To protect the Plan Area, future groundwater quality water reclamation practices and imported water quality must continue to be reviewed and future decisions should consider long-term effects on groundwater quality.

2.4.3 Migration of Contaminated Groundwater

The regulation of contaminated groundwater flow is critical for protecting groundwater currently in use within the Plan Area. Groundwater contamination can be through anthropogenic activities or naturally occurring. Contamination can come from various activities, including irrigation, pesticide application, septic tanks, industrial sources, stormwater runoff, and disposal sites. Several areas in the USLR Valley Groundwater Subbasin show increased levels of TDS and nitrate, likely from agricultural legacy.

Several State of California online databases provide information and data on known groundwater contamination sites, including those undergoing current remediation, and groundwater quality for select wells in the subbasin. These databases are discussed in Section 2.2.1.1.3. The only case in the subbasin that is still currently open represents a former plastics recycling operation, which is being monitored for lead-impacted soil that has been capped in-place.

Increased understanding of contaminated sites and improved cleanup efforts result from open sharing of information on the subbasin groundwater system, contamination sites, and water wells by coordinated local regulatory agencies. Advancements in treatment technologies also have the potential to renew contaminated groundwater into a source of potable or non-potable groundwater. Additional discussion of water quality conditions in the subbasin is presented in Section 3.0 (Basin Setting).

2.4.4 Well Abandonment and Well Destruction Program

Preventing the migration and introduction of surface contaminants to the connected aquifer system by an existing abandoned or incorrectly constructed well requires proper destruction of the well. This typically involves completely filling in a well in accordance with standard procedures. In USLR Valley Subbasin, the San Diego County DEH administers all water well and monitoring well destructions. Procedures for proper well destruction are provided in the California Well Standards, Bulletin 74-90 (DWR, 1991).

2.4.5 Well Construction Policies

As mentioned in Section 2.3.3, the San Diego County DEH Land and Water Quality Division issues permits for all water well construction in the basin, consistent with DWR regulations. Under County regulation, inspections take place during several stages of well construction to ensure all standards listed in the California Well Standards, Bulletin 74-90 (DWR, 1991), are met. Once installation is complete, all drinking water wells are evaluated to confirm compliance with minimum drinking water standards. DEH requires water samples to be collected by a qualified individual with California certification, specialized training, or experience and that well water testing be completed by a certified drinking water laboratory. Water testing results must be submitted to DEH within one year of the testing. A clearance letter authorizing use is issued to the homeowner once the water well is found to be in compliance, after construction is finalized. As of July 1, 2018, the County of San Diego no longer provides water sample services.

2.4.6 Efficient Water Management Policies

Water conservation is a key part of water demand management and efficient use of water in the basin. The Water Authority, its member agencies, and the SDFB have provided technical and financial support for agricultural water use efficiency (WUE) in the San Diego Region since the 1980s (Weinberg and Jacoby, 2016a). The goal of the program is to provide technical assistance to growers to enable them to irrigate crops as efficiently as possible in order to obtain the maximum economic benefit from limited water resources.

In addition, Ordinance No. 100 – 08 establishes regulations to be implemented during times of declared water shortages or declared water shortage emergencies. It establishes four levels of drought response actions to be implemented in times of shortage, with increasing restrictions on water use in response to worsening drought conditions and decreasing available supplies. In order to help encourage WUE and efficient water management practices (EWMPs), YMWD has implemented both transitional special agricultural water rates (TSAWRs) and commercial agricultural (non-TSAWR) uniform water rates.

Potential additional water use management policies are discussed in Section 6.0 (Projects and Management Actions).

2.4.7 Relationships with State and Federal Regulatory Agencies

The PVGSA has been established to create this formal GSP for the USLR Valley Groundwater Subbasin. The GSP and related reports and documents will be submitted to DWR. Continued coordination and cultivation of new connections with Federal and State agencies is crucial for the continued sustainable management of the subbasin's groundwater. Federal and State agencies provide grant funding and loans, information, and services related to monitoring, water rights, and contamination sites.

The development of working relationships with the following federal and state regulatory agencies should continue to be pursued:

- Federal
    - United States Geological Survey (USGS)
- State
    - Department of Public Health (CDPH)
    - Department of Water Resources (DWR)

2.4.8 Groundwater Dependent Ecosystems

Groundwater Dependent Ecosystems (GDEs) are defined under SGMA as "ecological communities of species that depend on groundwater emerging from aquifers or on groundwater occurring near the ground surface" (23 CCR §351(m)). The USLRRCD has several conservation easements for Arroyo Toads in the USLR Valley Groundwater Subbasin, but these habitat areas are primarily dependent on seasonal surface water and the vernal pools created after storm events. Additional discussion is provided in the Basin Setting section of this GSP (Section 3.3.4.5).

2.5 Notice and Communication (§354.10)

Under the requirements of SGMA, GSAs must consider interests of all beneficial uses and users of groundwater when developing a GSP. As a result, the GSP development needs to consider effects to other stakeholder groups in or around the groundwater basin with overlapping interests. These interests include, but are not limited to, holders of overlying groundwater rights (including agriculture users and domestic well owners), public water systems, local land use planning agencies, environmental users, surface water users, federal government, California Native American tribes, and DACs.

The development of a GSP is a collaborative process involving all interested stakeholders. Public input is critical to the success of the USLR Valley Subbasin GSP and was a key component of its development. Notification and communication activities for the development of this GSP were guided by the Public Involvement Plan (Appendix 2a). The following tactics were implemented throughout the development of the GSP:

- **Stakeholder list:** developed, maintained, and updated throughout the GSP process. A list of interested parties was developed from responses to public outreach activities described below.
- **Stakeholder letters:** distributed to every registered parcel owner within the subbasin and posted in community areas, such as the local post office. Two letters were sent out: one on December 4, 2020, and a follow-up letter on January 5, 2021. These letters provided background on SGMA, conveyed the desire of the GSA to include meaningful participation in the development of the GSP, informed stakeholders of the project, and directed them to the project website where they could sign up for regular updates and access posted information. The stakeholder letters included both an English and a Spanish version. The mailing list was developed using multiple sources of land ownership including, but not limited to, SANDAG Parcel Mapping Tool, and private well owner listing maintained by YMWD and the County of San Diego Parcel Tax Rolls. Contained within these lists were owners of all parcels located within the DAC areas indicated on Figure 2-6.
- **Project webpage:** maintained under the YMWD website, the project webpage contains project information and resources, opportunities to provide feedback, and information on how to contact the project team. Available at: https://www.yuimamwd.com/newdev/65-services/143-gsp.
- **Project fact sheet:** provides general information about SGMA, the PVGSA, and development of the USLR Valley GSP. Available on the project webpage.
- **Virtual stakeholder meetings:** held remotely due to COVID-19, these meetings educate stakeholders and solicit incremental feedback and review of sections of the GSP. During the stakeholder outreach meetings, draft GSP content was reviewed in depth, specific questions were asked of the stakeholder, participation in data collection was requested, and stakeholder questions were noted by the consultant, answered and any suggestions arrived by discussion were included in the GSP. It should be noted that rather than offering contributions to GSP content, most concerns of the stakeholders that participated were directly related to potential cutbacks and what their potential water allocation would be in relation to the water budget.
- **E-blasts:** sent to participants on the stakeholder list to provide project updates and meeting announcements, request participation in data collection, and provide draft GSP content for review. E-blasts were also sent to the original interested parties list developed by the County of San Diego during the initial process of developing the GSA as well as YMWD customers, which included the documentation sent out in the December 4, 2020, and January 5, 2021 mailed letters.
- **Presentations:** to provide information at meetings held by the GSA and at stakeholder outreach workshops. PDFs of the presentation slides were made available on the project webpage.

Public meetings at which the Plan was discussed or considered by the GSA include:

June 24, 2020	January 27, 2021*	September 15, 2021
July 30, 2020	March 3, 2021	October 6, 2021*
August 26, 2020	March 24, 2021*	November 9, 2021
September 23, 2020	April 7, 2021	November 15, 2021*
October 28, 2020	June 2, 2021	December 6, 2021
June 24, 2020	June 16, 2021*	December 8, 2021*
December 9, 2020	June 30, 2021	January 21, 2022

*Stakeholder outreach workshops

Following issuance of the administrative draft GSP in November 2021, a 45-day public comment period was held. Comments regarding the administrative draft GSP received by the GSA and a summary of GSA responses are included as Appendix 2b. Original comment letters have been updated to the GSP portal, available here: https://sgma.water.ca.gov/portal/gsp/init/comments/154. The Public Involvement Plan only encompassed the activities and timeline for the GSP development phase; public involvement for the implementation phase of the GSP was included in the Project and Management Actions of the GSP (Section 6.0).

2.5.1 Pauma Valley GSA Decision Making Process

The GSA Executive Committee is comprised seven (7) members; two voting members appointed by each party plus one ex officio member. All final decisions are on a consensus basis. A consensus as used for this purpose means a majority vote of all voting members of the Executive Team on any given decision.

The Team established two work groups during the development of the GSP. Each workgroup consisted of one voting member from each party plus a representative for the ex officio member per work group. The work group was tasked with working with the GSP Consultant and YMWD General Manager to perpetuate the development of the GSP. The groups assisted with data collection and GSP section development.

Once a section, or significant portion of the GSP was deemed complete, the sections were than brought to the GSA Executive Committee for review, revisions, and approval to be presented to the public through Stakeholder engagement meetings.

The administrative draft of the GSP was completed, reviewed and approved by the Executive Committee for release to public for a 45-day review and public comment period. During the 45-day public review and comment period, each of the parties Board of Directors also reviewed the Draft GSP in preparation for final approval and submittal to the State.

After the 45-day review and public comment period is completed and the GSP is finalized, the Executive Committee will review and approve any changes made and brought the GSP to each of their respective Board of Directors for approval and submission to the State.

The GSA conducted 5 Stakeholder outreach meetings. At these meetings the consultant discussed the required content of a GSP, presented data collection information, water modeling results, and draft sections of the GSP. At each meeting the public was allowed to ask questions and make suggestions about how the sections might be improved by including relevant information. The consultant would then make revisions to the sections based on discussions during the stakeholder outreach meetings. During GSP implementation, the public will be notified of important developments or changes in the current status of the basin. The GSA will engage in water conservation and efficiency messaging to all stakeholders of the basin as well as establish a drought resiliency workgroup to assist with conservation messaging and stakeholder engagement in drought resilience monitoring of the basin to better avoid the occurrence of undesirable results (see Section 6.0).

The USLR Valley Groundwater Subbasin is comprised of mostly Native American, Hispanic and White residents. In order encourage involvement in the GSP Development and continued involvement during GSP implementation, the GSA employs the use of dual language correspondence to all property owners and tribal nations located within the basin. Special invitations to tribal representatives of all tribes located within the basin and to the San Luis Rey Indian Water Authority to attend GSA Executive Team meetings, in addition to stakeholder outreach meetings were extended during GSP development and will continue throughout the GSP implementation process. More importantly, the GSA will convene an Interactive Tribal Work Group to encourage tribal participation, promote basin balancing maintenance activities, and ensure respecting of federal reserve water rights.

The GSA will utilize electronic (email and website postings), traditional mail, and possible social media methods to communicate and inform the public about the GSP implementation process and the necessity to perform any project or management actions as described in the GSP.

2.5.2 Joint Powers Authority (JPA)

The PVGSA has developed a draft JPA, and implementing agreement, consisting of the existing members of the PVGSA, and possibly one or more additional GSA eligible “local agencies”. SLRIWA has been offered two voting seats on the JPA (out of a total of ten votes) in order to ensure that FRWR are fully respected, but perhaps more importantly, to facilitate a collaborative and constructive approach to water management, much as pertains in the Santa Margarita system where the Pechanga Tribe has a permanent seat on the Santa Margarita River Watermaster and works collaboratively with its neighbors in the Santa Margarita River watershed.

2.6 References (§354.4(b))

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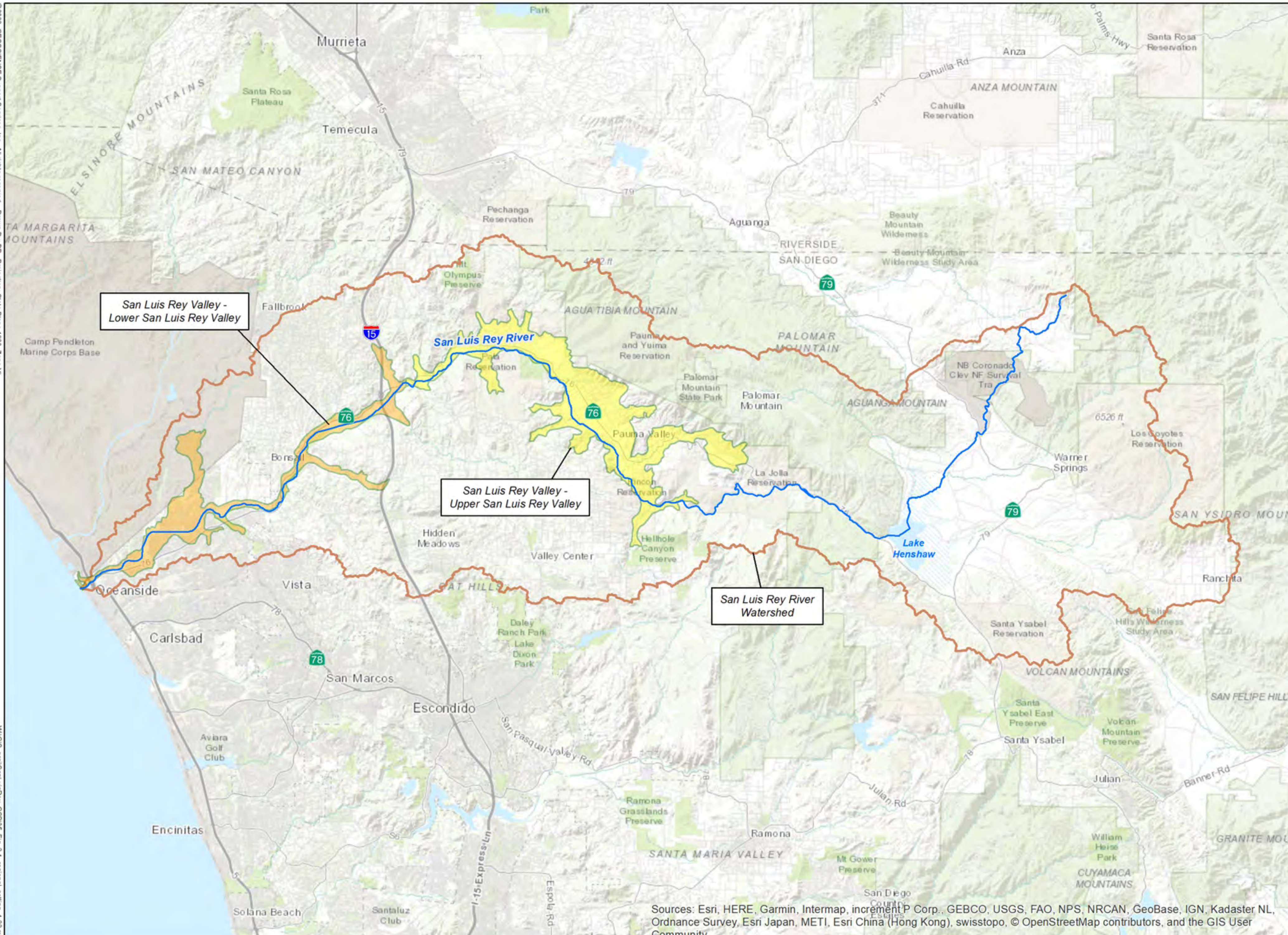
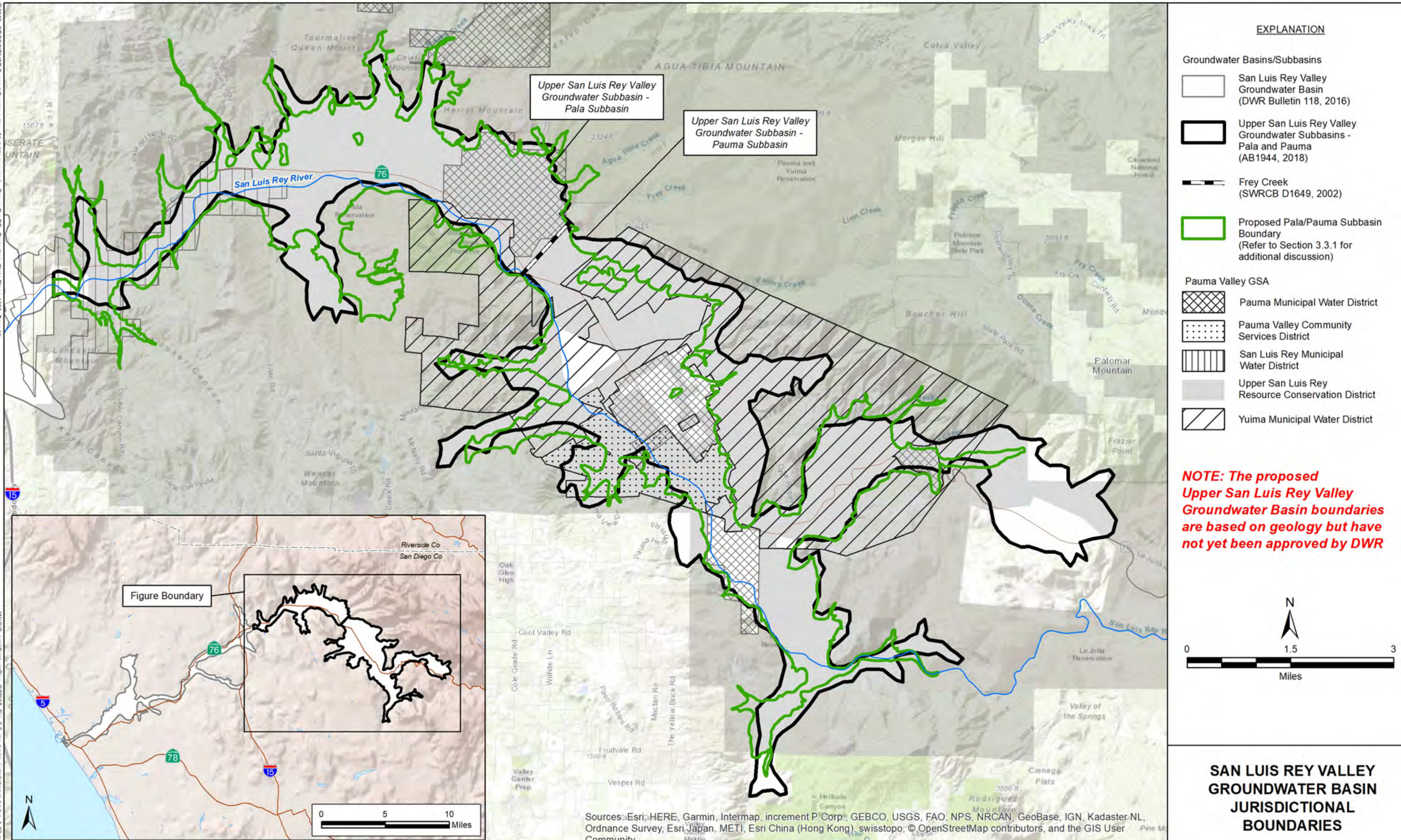


 Drawn By: DB. Projection: State Plane 1983, Zone VI.

UPPER SAN LUIS REY VALLEY SUBBASIN SETTING

Jan-22

FIGURE 2-1



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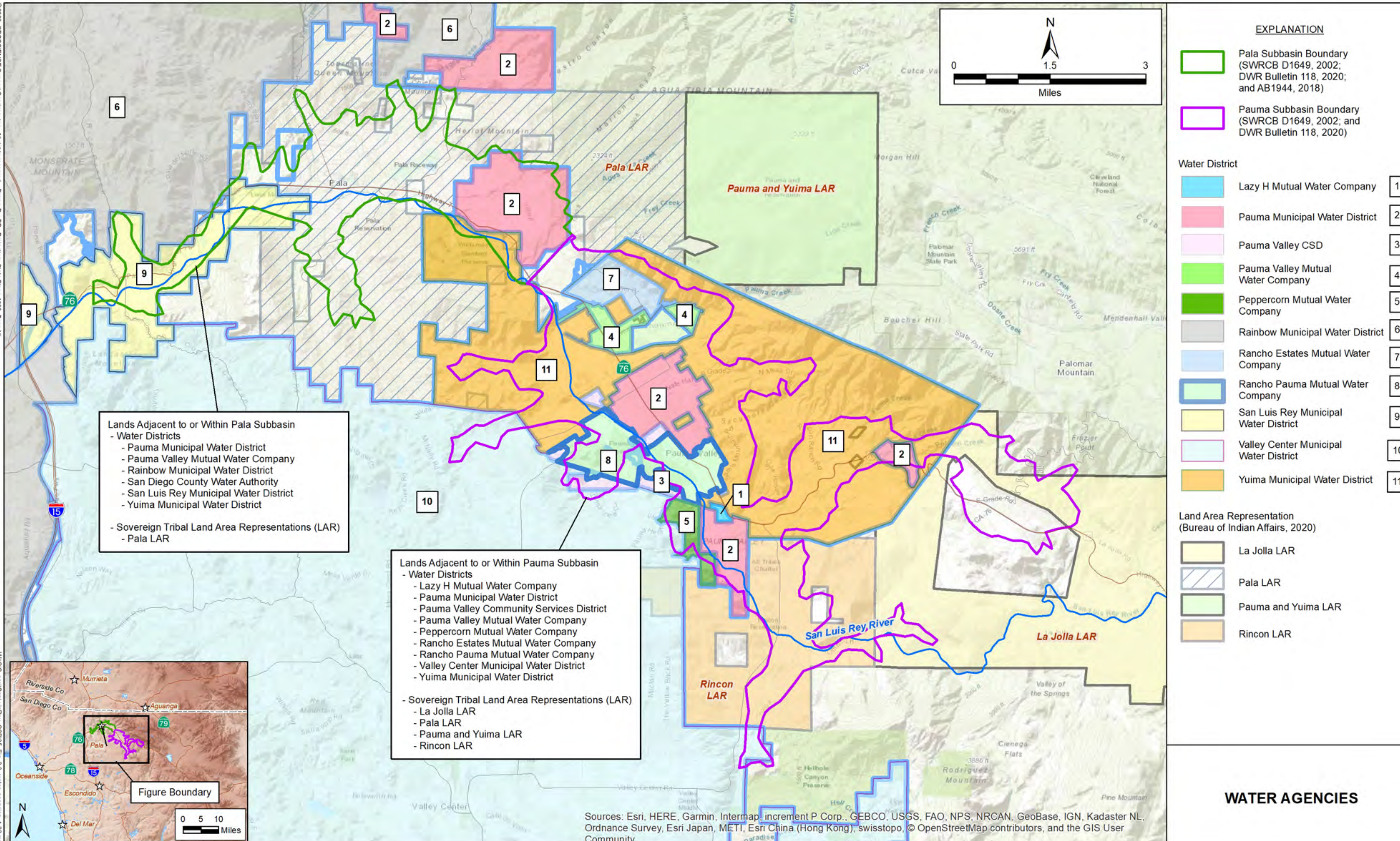
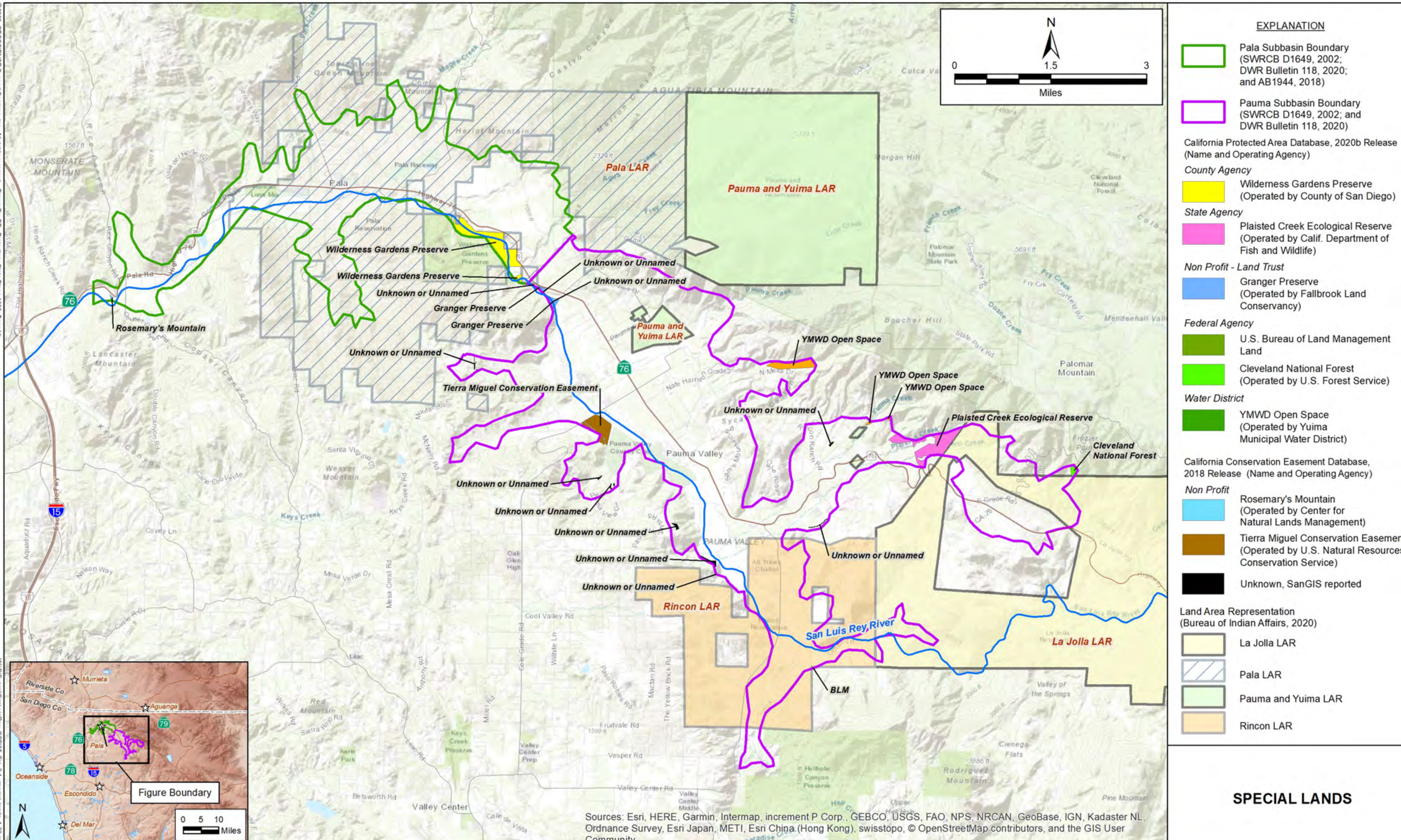
SAN LUIS REY VALLEY GROUNDWATER BASIN JURISDICTIONAL BOUNDARIES



Jan-22

WATER AGENCIES

FIGURE 2-3



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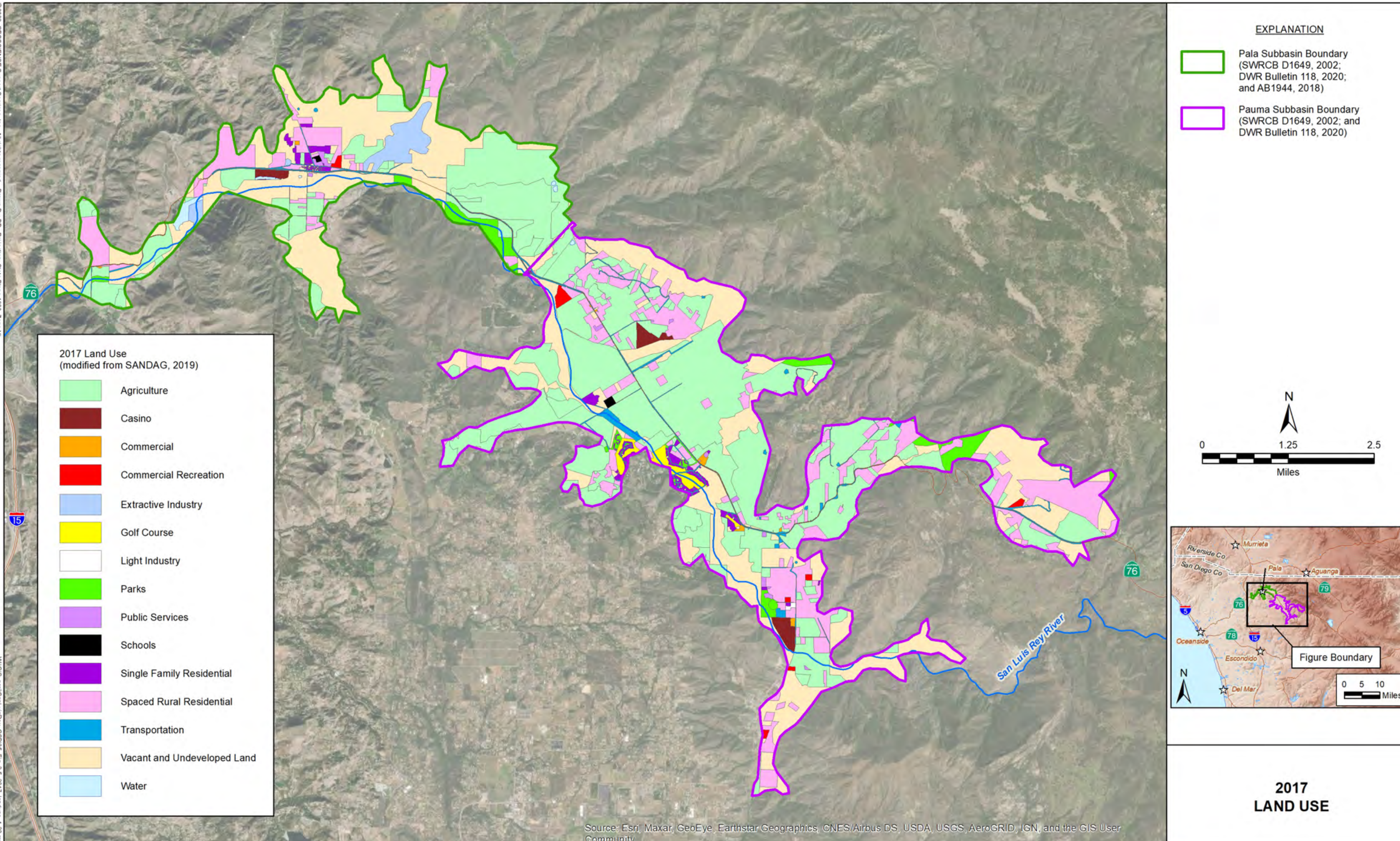
PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 2-4

GEOSCIENCE



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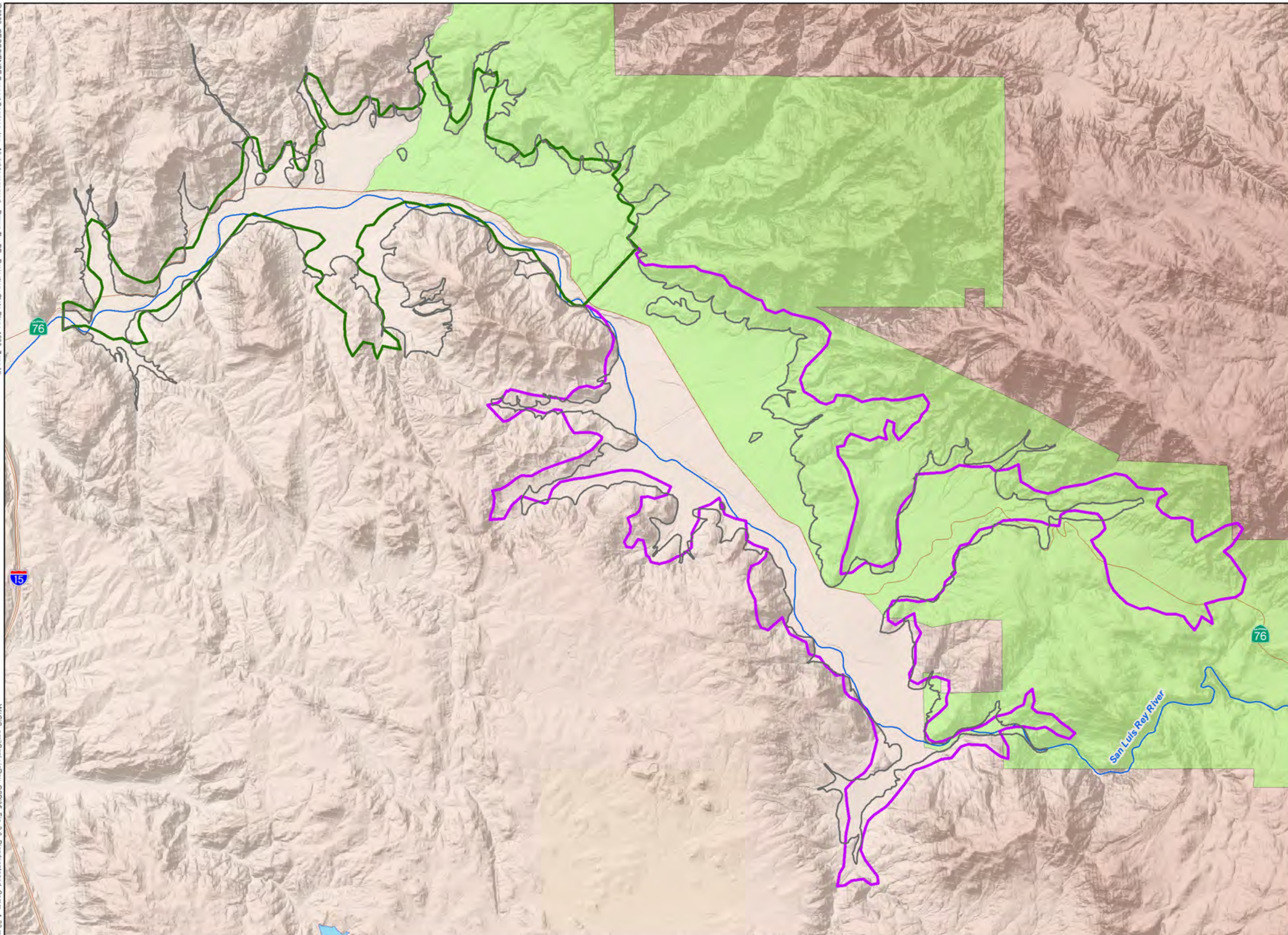
PAUMA VALLEY GSA **DRAFT** **FIGURE 2-5**

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Severly Disadvantaged Communities (SDACs) Block Group Mean Household Income is less than $42,737. (Source: ACS, 2014-2018)

Proposed Pala/Pauma Subbasin Boundary (Refer to Section 3.3.1)

N

0 1.25 2.5

Miles

DISADVANTAGED COMMUNITIES

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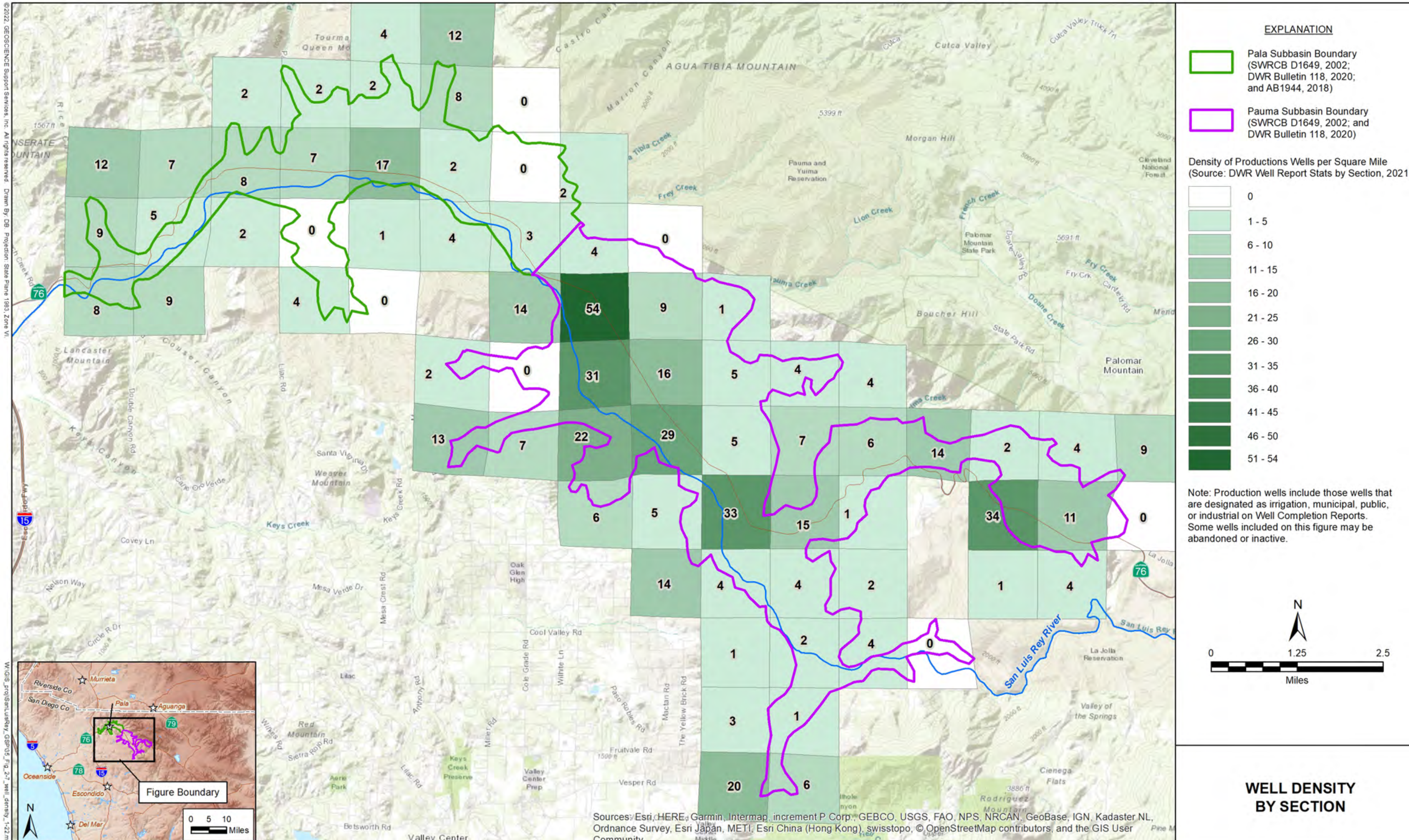
FIGURE 2-6

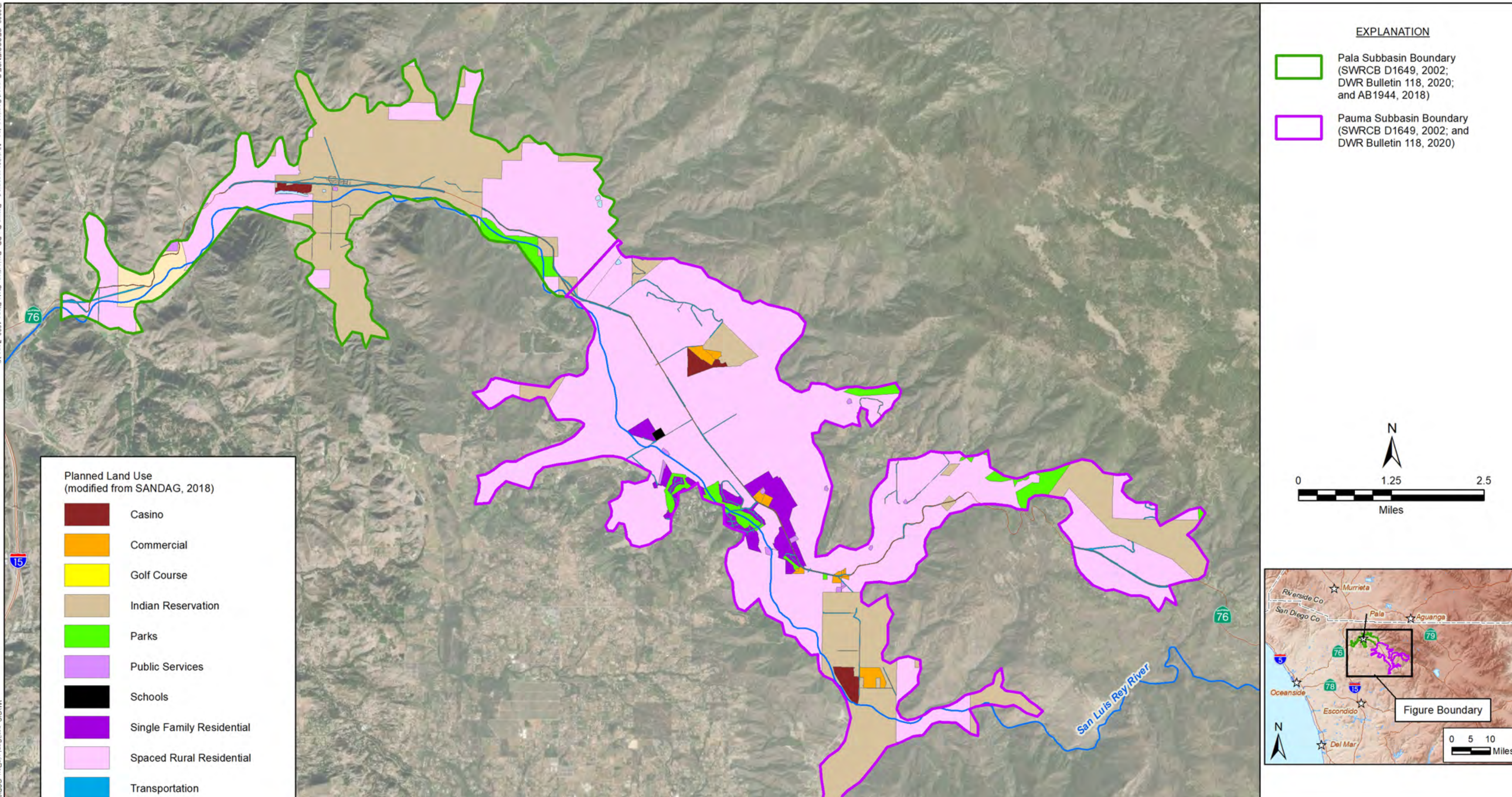


Jan-22

PAUMA VALLEY GSA **FIGURE 2-7**

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



PLANNED LAND USE

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3.0 Basin Setting (§354.12)

The Basin Setting section describes the physical components of the USLR Valley Groundwater Subbasin and provides a hydrogeologic conceptual model[8] for the understanding of groundwater conditions in the subbasin and development of groundwater budgets. The hydrogeologic conceptual model presented here is based on previous reports, publicly available data, and information provided by the GSA and basin stakeholders. The conceptual model will continue to be updated as new information becomes available.

3.1 General Setting (§354.14(d))

The USLR Valley Groundwater Subbasin (DWR subbasin 9-007.01) includes the Pauma and Pala Subbasins and encompasses approximately 19,200 acres in San Diego County. The valley areas are separated by narrow, steep-walled canyons and underlain by unconsolidated alluvial fill that serve as storage for groundwater. Elevation ranges from approximately 250 ft above mean sea level (amsl) in valley areas to over 5,700 ft amsl in the surrounding watershed area. The majority of land in the groundwater subbasin is used for agriculture, consisting primarily of citrus, avocados, and sub-tropical fruits.

3.1.1 Geography

The USLR Valley Groundwater Subbasin, located approximately 20 miles east of the Pacific Ocean, is bounded to the north by Mount Olympus, Tourmaline Queen Mountain, Chief Mountain, Heriot Mountain, and Agua Tibia Mountain. Boucher Hill, Palomar Mountain, and Rodriguez Mountain bound the subbasin to the east while Weaver Mountain, Pala Mountain, and Lancaster Mountain bound the south and southwest subbasin areas (Figure 3-1). Northwest of Pala Subbasin lie the Santa Margarita Mountains. These mountains continue north along the western side of the Elsinore-Temecula trough, a pronounced topographic and structural depression caused by movement along the Elsinore fault zone. The end of the USLR Valley Groundwater Subbasin (i.e., downstream end of Pala Subbasin) is defined by the Monserate Narrows, located between Monserate Mountain to the north and Lancaster Mountain to the south.

The main surface drainage feature in the area is the San Luis Rey River. The San Luis Rey River flows in a northwesterly direction through Pauma Subbasin and into Pala Subbasin, where it turns to the southwest and flows through the Monserate Narrows and into downgradient Bonsall Subbasin.

Vegetation in the Plan Area includes chaparral, coastal sage scrub, and oak woodland (Recon, 1996).

3.1.2 Climate

The general climate of the area is Mediterranean, with warm, dry summers and mild winters, although temperatures do occasionally fall below freezing. Most precipitation falls between the months of November and April with infrequent rain the rest of the year (particularly in summer months). Precipitation is also two to three times greater in the surrounding hills and mountain areas than in the

[8] A hydrogeologic conceptual model provides an understanding of the general physical characteristics related to regional hydrology, land use, geology and geologic structure, water quality, and principal aquifers/aquitards (DWR, 2016).

valley areas (Ellis and Lee, 1919). Cyclic hydrologic patterns are common, including wet periods of above-average rainfall and dry periods (drought) with below-average rainfall. Therefore, year-to-year rainfall can be highly variable. Historical annual rainfall at the National Oceanic and Atmospheric Administration (NOAA) precipitation station at Henshaw Dam is shown on Figure 3-2, along with the cumulative departure from mean annual precipitation. This gage has the most complete and extensive precipitation record available in the vicinity of the USLR Valley Groundwater Subbasin.

Average annual precipitation for the period from 1943 through 2020 is approximately 24.3 inches. Since this station is located at a higher elevation than the majority of the groundwater subbasin, precipitation in the valley areas is expected to be less (actual recharge from precipitation was estimated from isohyetal contours of precipitation – more accurately representing rainfall in the valley areas – during the development of water budgets in Section 3.3.5). Nevertheless, the cumulative departure from precipitation provides a good illustration of precipitation patterns through time. On this figure, an increasing slope in the cumulative departure indicates a period of above average precipitation (i.e., wet hydrologic period) while a declining trend or slope indicates a period of below average precipitation (i.e., dry hydrologic period).

3.2 Geology (§354.14(a),(b),(c),(d))

3.2.1 Regional Geologic and Structural Setting

The USLR Valley Groundwater Subbasin lies within the Peninsular Ranges Physiographic Province of Southern California, which is characterized by mountainous ridges and hills interspersed by intermountain valleys and basins. The Peninsular Ranges have been subject to a range of tectonic forces, including faulting, tilting, regional uplift, and subsequent erosion. The regional uplift the area has experienced caused the San Luis Rey River to incise a canyon through what is now the Pauma and Pala Valleys – deeper than its current elevation (Ellis and Lee, 1919; Howes, 1955). Later lowering of the area led to the filling of the river cut valleys with fluvial and alluvial material. Additional uplift caused the river to erode back through these deposits to a degree, to its current elevation. At the same time, alluvial fans developed along the basin boundaries, particularly along the northern/eastern side of Pauma Valley. The downcutting and backfilling of the alluvial basins was also influenced by fluctuations in sea level, which fell approximately 300 to 400 ft below its present level near the end of the Pleistocene (DWR, 1965).

The main structural feature in the Plan Area is the Elsinore fault zone, which runs northeast of the Valley (Figure 3-3). The Elsinore fault zone represents the westernmost onshore branch of the San Andreas fault system and extends over 200 km from the southern Los Angeles Basin into Mexico (where it becomes known as the Laguna Salada fault). Three distinct segments of the Elsinore fault are thought to exist in the Plan Area: a strike slip segment northwest of Pala Valley, by Agua Tibia Mountain; a transitional strike-slip segment causing regional transpression north of Frey Creek, and a predominantly thrust faulted segment in Pauma Valley (Howes, 1955; Vaughan, 1987). There is also the nearby Tecolote fault, which forms the boundary between the San Marcos gabbro underlying Pala Mountain and the Bonsall tonalite to the southwest (refer to Section 3.2.2 for discussion of local rock formations), extends to the north under the alluvium-filled valley, and eventually merges with the Elsinore fault zone in the vicinity of Sycamore Canyon.

Repeated and prolonged uplift along the Elsinore fault, primarily during the Pleistocene, has created higher elevations to the northeast and lower elevations in the valley area to the southwest (Howes, 1955). The majority of uplift has occurred in Pauma Valley (Vaughan, 1987). Here, a restraining bend in the Elsinore fault, known as the Palomar bend, causes thrust faulting with a strike-slip component (Howes, 1955; Vaughan, 1987; Vaughan et al., 1999). Uplift of Agua Tibia Mountain largely occurred during the middle Pleistocene as the result of transpressive stresses associated with movement along the Elsinore fault, particularly from this restraining bend (Vaughan et al., 1999).

Other structural evidence of faulting along the Elsinore fault zone includes hourglass-shaped valleys on the sides of the surrounding mountains, steepened stream terrace gradients, deformed and tilted rock formations, extensive fracturing and localized brecciation/gouge zones, and offset alluvial fans (Howes, 1955; Vaughan, 1987). Estimates of right-lateral offset along the fault range from 0 to 40 km with a slip rate of approximately 4.9 +/- 2.0 mm/yr (Vaughan, 1987). Fracturing associated with the Elsinore fault zone is also thought to be a conduit for groundwater flow (Howes, 1955; Vaughan, 1987). Other structural features implied by confused rock associations in the basement complex indicate the existence of structural forces before the development of the groundwater basin. These features are not known to significantly affect groundwater conditions in the groundwater basin (DWR, 1965).

No major earthquakes have occurred along the Elsinore Fault in the USLR Valley Groundwater Basin since the establishment of the Pala Mission in 1816. Historic earthquake magnitudes along the Elsinore fault and geologic evidence of recent and significant tectonic movement suggest the fault is prone to larger (i.e., magnitude 7.0 and greater), infrequent earthquake events rather than smaller, frequent ones (Vaughan, 1987). Large earthquakes are thought to occur every 550 to 600 years (Vaughan et al., 1999).

3.2.2 Local Geology

The Pala and Pauma Valleys are underlain by valley fill consisting of flood plain and channel alluvial deposits, alluvial fan material, and localized lake deposits, with possible minor amounts of eolian (i.e., windblown) material. Of these, the stream and flood plain deposits tend to be more productive for groundwater due to the well sorted nature of the sediments and dominant presence of sands and gravels (Howes, 1955). Valley fill is surrounded by and underlain by Paleozoic and Triassic metasediments, Jurassic volcanics, and Cretaceous igneous rocks of the Southern California batholith. Tertiary and Quaternary extrusives (e.g., dikes) occur locally throughout the basement complex. A geologic map of the Plan Area is provided as Figure 3-3. Geologic cross-sections were also created using surficial geology, information on well driller’s logs (provided as Appendix 3a), and information from previous studies (Figures 3-4 through 3-7). The main geologic units found in the USLR Valley Groundwater Subbasin are discussed in more detail in the following sections.

3.2.2.1 Bedrock

The main crystalline rocks that represent the bedrock, or basement complex, of the San Luis Rey Valley Groundwater Subbasin include the Julian schist, San Marcos gabbro, Bonsall tonalite, and Woodson Mountain granodiorite. Rocks making up the basement complex provide only limited amounts of groundwater through fractures and joints – particularly where weathered bedrock is present. They therefore appear to have limited influence on groundwater in the basin proper (DWR, 1965). For the purposes of this GSP, since the bedrock is considered to be generally non-water bearing and therefore not a part of the groundwater basin, these crystalline units have been lumped together in the geologic map and cross-sections of the USLR Valley Groundwater Subbasin (Figures 3-3 through 3-7). They are also generally referred to as "bedrock" for the hydrogeologic conceptual model of the area. However, brief descriptions of each unit are provided below.

The Julian schist[9] (Triassic age), which is relatively resistant to erosion, forms many of the hills and ridges surrounding the Pauma Subbasin. Larsen (1948) hypothesized the schist originated from Triassic sedimentary rocks that were likely metamorphosed prior to emplacement of the batholith in the early Upper Cretaceous.

The San Marcos gabbro[10] (Cretaceous age) is less resistant that some of the other surrounding igneous and metamorphic rocks and may have a crumbly appearance in outcrops. In areas where the rock is more competent, like northwest of the Agua Tibia ranch house, large boulders are quarried as "black granite" (Howes, 1955).

The Bonsall tonalite[11] (Cretaceous age) is the most common rock type in the vicinity of the basin. It is thought that the tonalite was injected into the older San Marcos gabbro before the gabbro completely solidified – leading to a large number of grabbroic inclusions within the tonalite (Howes, 1955).

Woodson Mountain granodiorite[12] (Cretaceous in age) is highly resistant to erosion and often appears as huge boulders in exposures, such as those found on Woodson Mountain for which it is named.

Pegmatite[13] *dikes*[14] (Upper Cretaceous in age) are common in the bedrock surrounding USLR Valley Groundwater Basin, particularly the San Marcos gabbro and Bonsall tonalite, and stand out in relief due to their resistance to erosion. Near Pala, these pegmatites have been mined for semi-precious stones like kunzite and tourmaline.

Residuum and colluvium deposits represent the weathered surface of local bedrock, occurring primarily on the flanks of valleys tributary to the main San Luis Rey River valley. They typically do not represent a major source of groundwater but may be important sources for groundwater recharge (DWR, 1965).

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9 Schist is a medium-grade metamorphic rock formed from the altering of mudstone or shale through heat and/or pressure. It has medium to large, flat, sheet-like grains in a preferred orientation (nearby grains are roughly parallel).

10 Gabbro is a phaneritic (coarse-grained), mafic (dark-colored) intrusive igneous rock formed from the slow cooling of magnesium-rich and iron-rich magma inside the earth.

11 Tonalite is an igneous, plutonic (intrusive) rock, of felsic (lighter colored and silica-rich) composition, with phaneritic texture.

12 Granodiorite is a phaneritic-textured intrusive igneous rock similar to granite, but containing more plagioclase (sodium or calcium) feldspar than orthoclase (potassium) feldspar.

13 Pegmatite is an igneous rock, formed by slow crystallization at high temperature and pressure at depth, and exhibiting large interlocking crystals usually greater in size than 1 inch.

14 A dike is a sheet of rock that is formed in a fracture of a pre-existing rock body. Magmatic dikes form when magma flows into a crack then solidifies as a sheet intrusion, either cutting across layers of rock or through a contiguous mass of rock.

3.2.2.2 Alluvial Fill

There are four main classifications for the alluvial fill in the USLR Valley Groundwater Basin:

- Older alluvium (Pleistocene age),
- Lakebed (lacustrine) deposits (Pleistocene age),
- Alluvial fan deposits (Pleistocene age), and
- River channel deposits / younger alluvium (Holocene age).

Surrounding outcrops of Woodson Mountain granodiorite, Bonsall tonalite, San Marcos gabbro, Julian schist, and pegmatite dikes represent the primary source material for valley fill. Alluvial sediments in valleys are generally thickest under the San Luis Rey River. In Pauma Valley, sediments may be up to 600 ft thick in localized areas of the northeast portion of the subbasin (Layne, 2010). However, these locations with greater sediment depth typically coincide with alluvial fan deposits, which tend to be less productive. Alluvial fill is shallower in the Pala Subbasin than thicknesses found in Pauma, with a maximum depth of approximately 240 ft (Moreland, 1974). The majority of pumped groundwater in this subbasin comes from younger alluvium.

3.2.2.2.1 Older Alluvium

Older alluvium consists of well sorted layers of gravel, sand, silt, and clay up to 160 ft thick (Moreland, 1974). While this unit is generally only associated with the Pauma Subbasin (DWR, 1965; Mooreland, 1974), the cemented nature of alluvial materials from well logs within Pala Subbasin and recent geologic mapping (Bedrossian et al., 2012) indicate that older alluvial materials may also be present in the Pala Subbasin. As such, this unit has been represented in the geologic cross-sections in Pala (Figures 3-4 and 3-5).

3.2.2.2.2 Lakebed Deposits

Many of the wells in the Pauma Subbasin have records of an organic-rich, black clay or mud layer ranging in thickness from 4 to 10 ft, typically found about 90 ft bgs (DWR, 1965; Howes, 1955). It is believed that this layer represents lakebed deposits from paleo Lake Pauma, which existed during the Pleistocene due to the temporary damming of the San Luis Rey River by the Agua Tibia alluvial fan during a period of rapid uplift. The lake has been estimated to be approximately 4 miles long and 1 to 1.5 miles wide with a maximum depth of approximately 147 feet (Howes, 1955). Eventually, overflow of dammed water eroded the Agua Tibia fan material, draining the lake and establishing the current stream channel for the San Luis Rey River. Well-stratified, fine-grained deposits in portions of the Pala Subbasin indicate that local (smaller) damming events may have also occurred in this area (DWR, 1965).

3.2.2.2.3 Alluvial Fan Deposits

The main alluvial fan deposits in the Plan Area are located in the Pauma Subbasin and include the Agua Tibia, Pauma Creek, and Rincon fans. They are composed of heterogeneous and poorly sorted materials from source rocks to the north and east, and the encroachment of these fan materials into the basin has pushed the San Luis Rey River against the valley wall to the southwest (Howes, 1955).

In the Pauma Subbasin, alluvial fan deposits can be as much as 370 ft thick (Moreland, 1974). They are generally poorly sorted in nature, consisting primarily of rock fragments ranging in size from clay to boulders more than 5 ft in diameter. They generally have lower groundwater yields than the other alluvial materials. However, they have been found to be in hydraulic continuity with the San Luis Rey River underlying sediments and provide an important source of recharge (DWR, 1965).

3.2.2.2.4 Younger Alluvium

Recent alluvium consists primarily of sand, gravel, and silt with only minor occurrences of clay. River-channel deposits range from 0 to 130 ft thick in Pauma Subbasin (Moreland, 1974). Fill of the USLR valley is connected to the lower valley through canyon fill in the Monserate Narrows.

3.2.3 Soil Characteristics

Soil type and distribution affects infiltration, surface runoff, interflow, groundwater storage, and deep groundwater losses. Maps of soil coverage in the Plan Area are available through the United States Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) (USDA NRCS, 2020). Their Soil Survey Geographic Database (SSURGO) contains information about soil as collected by the National Cooperative Soil Survey over the course of a century. There are four basic hydrologic soil groups under the SSURGO classification system (Group A through D), which are based on soil texture and properties. SSURGO describes each type as the following:

- Group A soils have a high infiltration rate (low runoff potential) when thoroughly wet. They consist mainly of deep, well drained to excessively drained sands or gravelly sands and have a high rate of water transmission. Examples include sand, loamy sand, or sandy loam types of soils.
- Group B soils have a moderate infiltration rate when thoroughly wet. They consist mainly of moderately deep or deep, moderately drained soils that have moderately fine texture to moderately coarse texture and have a moderate rate of water transmission. This includes the silt loam and loam soils.
- Group C soils have a slow infiltration rate when thoroughly wet. They consist mainly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. They have a slow rate of water transmission. The predominant soil in this group is a sandy clay loam.
- Group D soils have a very slow infiltration rate (high runoff potential) when thoroughly wet. They consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. Therefore, they have a very slow rate of water transmission. This includes clay loam, silty clay loam, sandy clay, silty clay or clay type soils. Bedrock is also included in this group due to its very low infiltration rate.

In the USLR Valley Groundwater Subbasin, Group A soils typically represent the main streambed and alluvial fan deposits. This accounts for the majority of the groundwater subbasin area (Figure 3-8). Group B soils are also found along the flanks of alluvial fans in the subbasin with limited occurrences of Group C soils. Group C and D soils are typically located at the edges of the subbasin near bedrock outcrops.

3.3 Hydrology (§354.14(a),(b),(d); §354.16; §354.18)

3.3.1 Groundwater Basin Boundaries

Under SGMA, basin boundaries define the geographic area included in each groundwater basin or subbasin. The USLR Valley Groundwater Subbasin (DWR Basin 9-007.01) includes both Pauma and Pala Subbasins. The groundwater subbasin itself underlies a relatively narrow, alluvial-filled valley and is surrounded by crystalline bedrock forming relatively steep mountains. The latest version of Bulletin 118, published by DWR (2020a), provides official descriptions and evaluation of groundwater basins in California, including official groundwater basin boundaries. The most recent groundwater basin boundaries (2020a) are shown on Figure 3-1. In addition, Assembly Bill 1944 defines the boundary between the Upper and Lower San Luis Rey Valley Groundwater Subbasins as:

> *"the east line of Range 3 West, San Bernardino Meridian. The portion of the basin to the west of the dividing line shall be the Lower San Luis Rey Valley Groundwater Subbasin and the portion of the basin to the east of the dividing line shall be the Upper San Luis Rey Valley Groundwater Subbasin."*

The bottom of the groundwater basin has been estimated based on available information from well logs in the subbasin (and the creation of cross-sections shown on Figures 3-4 through 3-7) as well as previous investigations (Moreland, 1974; LGS, 2009; Layne, 2010). Bedrock is shallowest along the western side of the subbasin and generally slopes to the east-northeast (LGS, 2009).

During the course of developing this GSP, it has been found that the current basin boundaries do not adequately represent the true extent of the groundwater subbasin based on geologic contacts and topographic changes indicating the presence of crystalline bedrock. A process for redefining or refining groundwater basin or subbasin boundaries has been provided to local agencies through SGMA. However, the next basin boundary modification period is not expected before 2022. This GSP has been prepared using the currently-defined subbasin boundaries but sets the foundation for future modifications that would allow the groundwater subbasin boundaries to coincide with the geologic conditions present in the subbasin – particularly along the edges. Proposed modifications and an explanation of how these modifications will create a more realistic representation of actual conditions are discussed below. It is important to note that the hydrogeologic conceptual model presented in this GSP still applies to the USLR Valley Groundwater Subbasin as it is currently defined by DWR.

3.3.1.1 Potential Boundary Revisions

Requests for basin boundary modifications may be submitted to DWR periodically for either scientific or jurisdictional reasons. Scientific modifications are based on geologic or hydrologic conditions, while jurisdictional modifications change boundaries to promote sustainable groundwater management. In the case of the USLR Valley Groundwater Subbasin, future basin modifications are supported by scientific information in the form of geologic and topographic data.

As discussed in previous sections, the USLR Valley Groundwater Subbasin is underlain by and surrounded by crystalline bedrock. Since these geologic units are typically considered to have non- (or very low-) water-bearing capacity, they represent the base and edges of the groundwater subbasin. Bedrock contacts have been used in previous iterations of Bulletin 118 to define groundwater basin boundaries.

However, it appears that current boundaries may have been based on larger-scale geologic mapping that did not provide as much detail as some other sources currently available. This has led to areas of connected alluvial material being excluded from current basin boundaries while including portions of surrounding hard rock in other areas. These discrepancies are apparent in the surficial geologic map provided as Figure 3-3. Ideally, basin boundaries should generally coincide with the contact between alluvial materials (e.g., Younger Alluvium, alluvial fan deposits, or Older Alluvium) and bedrock.

Proposed groundwater basin boundaries for future revisions are shown on Figure 3-9 for Pauma Subbasin and Figure 3-10 for Pala Subbasin. The proposed boundaries were based on available geologic mapping supplemented by topographic information and aerial imagery. Since bedrock is generally much more resistant to weathering and erosion than sedimentary (i.e., alluvial) material, it stands out in greater topographic relief. Therefore, even when geologic mapping may not provide the level of detail necessary to define basin boundaries in certain locations, topographic information may be used as an indicator of the presence of bedrock. Bedrock is also often visible from publicly available aerial imagery and these maps were used to confirm proposed boundaries in certain areas.

As shown on Figures 3-9 and 3-10, the proposed basin boundaries coincide well with mapped alluvial/bedrock contacts and a sharp increase in topographic relief. A notable exception that warrants additional discussion is the far eastern portion of Pauma Subbasin. Here, a lobe of alluvial material currently included in DWR-defined basin boundaries has been removed from the proposed Pauma Subbasin extent. Based on a review of geologic mapping and available information, this area appears to represent an uplifted and flattened bedrock area overlain by shallow coverages of alluvium and colluvium/residuum. At the surface, it has been mapped as alluvium. However, based on the geologic coverage, review of driller's logs, topographic expression, and presence of visible bedrock outcrops, the alluvial material covering this area is likely thin. In addition, it is not believed that this area is connected to the main groundwater subbasin and its aquifer system(s). Topography and stream drainages indicate that groundwater and surface water flow in this area is to the south-southwest rather than parallel to topography (i.e., north and northwest, as suggested by current basin boundaries and the implied "connection" along Plaisted Creek). Any groundwater outflow from this alluvial lobe would likely surface as rising groundwater at the southern bedrock boundary and travel down the unnamed creek as surface flow over bedrock to the San Luis Rey River or be lost to evapotranspiration.

3.3.2 Groundwater Occurrence and Aquifer Systems

DWR defines an aquifer as a "three-dimensional body of porous and permeable sediment or sedimentary rock that contains sufficient saturated material to yield significant quantities of groundwater to wells and springs, as further defined or characterized in Bulletin 118" (2018). The majority of groundwater in the USLR Valley Groundwater Subbasin is produced from the porous flood plain and alluvial material representing valley fill. The Pauma and Pala Subbasins are hydraulically connected, with groundwater from the upgradient Pauma Subbasin flowing into Pala Subbasin.

It is also common for wells within the valley and foothill areas to tap fracture systems in underlying and surrounding crystalline rock (with either part or all of the well the screen completed in bedrock). These fractured systems have a much lower storage capacity than the alluvial sediments and wells completed in hard rock typically experience lower production capacities. In addition, due to the nature of their secondary porosity (i.e., water is held within a connected network of fractures rather than interstitial pore spaces between sediment grains), these fractured aquifer systems can respond quickly to recharge and/or become depleted quickly without significant recharge. In many places, fractured systems are overlain by a zone of weathered bedrock and/or alluvium which may provide an additional source of water to the hard rock system (Howes, 1955). Well yield is also dependent on fracture density, connectivity, spacing, and orientation – all of which can vary greatly, even over short distances. Therefore, surrounding bedrock is not considered to be part of the aquifer system addressed in this GSP.

Due to the typically reduced capacity of these bedrock units to transmit reliable or significant quantities of groundwater to wells, bedrock is not considered to be an aquifer unit within the Plan Area. However, these units likely contribute some water to the overlying alluvial aquifer system in the form of mountain front recharge. In particular, the Elsinore fault is thought to be a conduit for groundwater flow. Groundwater traveling within fractures and fault splays associated with this structure may be intercepted by creeks transecting the fault, causing groundwater to flow into the USLR Valley Groundwater Basin as surface water or subsurface flow through the alluvial fans (Howes, 1955).

Several springs have been observed in the area, including Rincon spring at the top of the Rincon alluvial fan, springs along the trace of the Tecolote fault, and a former hot water spring on the northern side of the Agua Tibia alluvial fan (no longer flowing) (Howes, 1955). The source of the hot water is believed to be from surface water warmed at depth and transported to the surface along faults and/or fractures. Local faults and fractures are also thought to be the cause of other, non-hot water seeps and springs by impeding the lateral flow of water (causing rising groundwater levels and eventual daylighting of spring water) or transmitting water to daylighting canyons and outcrops.

3.3.2.1 Aquifer Characteristics

Younger alluvium represents particularly productive aquifer units while the alluvial fans tend to be less productive due to their poorly sorted nature and the presence of significant amounts of fine-grained material. In general, the Rincon alluvial fan is more productive than the Pauma Creek and Agua Tibia alluvial fans (Howes, 1955). Wells constructed in the productive alluvial materials in Pauma and Pala Subbasin can produce several hundred gallons per minute (gpm) (Stetson, 1984). Moreland (1974) estimated the specific capacity of alluvium and river channel deposits to range from 13 to 115 gpm/ft, with a hydraulic conductivity of approximately 750 gpd/ft^2, or about 100 ft/d.

Productivity generally decreases with decreasing thickness of unconsolidated material. Alluvial sediments in valleys are generally thickest under the San Luis Rey River. In Pauma Valley, sediments may be up to 600 ft thick in localized areas of the northeast portion of the subbasin (Layne, 2010). However, these locations with greater sediment depth typically coincide with alluvial fan deposits, which tend to be less productive. Alluvial aquifer systems are typically unconfined in nature, though localized semi-confined and confined conditions may exist where substantial lacustrine deposits are present (i.e., areas underlying fine-grained lakebed deposits from paleo Lake Pauma) (Howes, 1955; Moreland, 1974).

Wells completed in fractured rock aquifers may only produce a few tens of gallons per minute (Layne, 2010), but groundwater production can be variable. Higher quantities of groundwater produced from these fractured systems depend on the well being located in an extensive network of open fractures (i.e., not mineralized) capable of supplying adequate amounts of water (Geoconsultants, 2009).

3.3.2.2 Aquifer Uses

The aquifers in the Pauma and Pala Subbasins are used for domestic, agricultural, commercial, and municipal water supply purposes. The majority of urban areas are supplied water by water agencies but there are some private wells that provide water for domestic use. Residential water uses include household consumption, irrigation of landscape and/or agricultural crops, watering horses or other livestock, and pumping water to fill swimming pools or ponds. Commercial uses include store front and retail trade strip malls, low-rise office buildings, libraries, post offices, and fire and police stations. Industrial uses include extractive industry (mining), light industrial, and warehousing/public storage. The majority of private pumping is used for agricultural irrigation. Estimated groundwater pumping is discussed in Section 3.3.3.2 – Groundwater Discharge and Section 3.3.5 – Water Budget Information.

3.3.3 Groundwater Recharge and Discharge

Identifying sources and locations of groundwater recharge and discharge is an essential component of the hydrogeologic conceptual model as well as for the development of water budgets for the USLR Valley Groundwater Subbasin. In general, sources of inflow to the Pauma and Pala Subbasins include ungaged and gaged runoff from the surrounding watershed areas, underflow inflow from neighboring mountain blocks, precipitation, and applied water. This translates to recharge from mountain front runoff, the direct infiltration of precipitation, percolation from streamflow, return flow from applied water (from both pumped groundwater and imported water), and the infiltration of treated wastewater. Sources of outflow/discharge chiefly consist of groundwater pumping, surface water flow out of the groundwater subbasin and into downgradient Bonsall Subbasin (including the contribution from rising groundwater), and evapotranspiration. These main physical sources are discussed briefly in the following sections.

The conceptual understanding of groundwater recharge and discharge terms were developed further during the construction of an integrated surface water and groundwater model of the USLR Valley Groundwater Subbasin, which was calibrated to observed surface flow and groundwater elevations and used to evaluate water budgets for the subbasin. Assumptions and methods for quantifying individual groundwater recharge and discharge terms and simulating them in the model are discussed in Section 3.3.5, below.

3.3.3.1 Groundwater Recharge

3.3.3.1.1 Recharge from Mountain Front Runoff

While crystalline bedrock is typically assumed to have a negligible contribution to groundwater flow, the numerous faults and fractures present in the low-permeability bedrock surrounding the USLR Valley Groundwater Subbasin allow the mountain block to represent a significant source of recharge. The Elsinore fault zone, in particular, is thought to be a conduit for groundwater flow to the subbasin. Recharge from mountain front runoff includes both recharge from ungaged surface runoff and subsurface inflow, and is assumed to occur along the contact between upgradient outcrops of bedrock and downgradient alluvial materials. Recharge from mountain front runoff includes contributions from recharge and runoff from natural precipitation and the application of water at land surface in surrounding foothill and mountain area.

3.3.3.1.2 Areal Recharge from Precipitation

Areal recharge refers to the process by which a fraction of the precipitation that falls on the ground within the basin infiltrates downward beyond the root zone where evapotranspiration (ET) may occur. This deep percolation is assumed to eventually recharge the groundwater system. Precipitation falling on the ground surface may also run off and converge in tributaries, be consumed via ET, be held in storage in the root zone, or be held in storage in the vadose zone above the groundwater system. A fraction of the precipitation that runs off may also become deep percolation along the tributary drainages and is included in the term areal recharge in this report. The amount of precipitation that eventually becomes areal recharge is determined by many factors, including the amount, intensity, and timing of precipitation; soil properties such as the storage capacity and depth of soils; topography; the amount of ET by vegetation; the permeability of the aquifer; and land use changes that affect the infiltration capacity of the land surface.

3.3.3.1.3 Streambed Percolation

Streamflow provides a considerable amount of recharge to the USLR Valley Groundwater Subbasin by conveying water from surrounding mountainous areas (where the greatest concentration of precipitation falls) to the groundwater basin, allowing the water to become recharge through streambed infiltration. In general, the amount of recharge from streambed percolation depends on the conductance of the streambed materials, streambed geometry, water levels in the surrounding groundwater system, and amount of streamflow.

Ellis and Lee (1919) estimated that approximately ten percent of all precipitation becomes runoff and contributes to streamflow in the San Luis Rey River. For this GSP, a surface water model was developed to calculate surface runoff based on soil type/coverage and associated parameters, land use, slope (topography), and applied water in the form of irrigation and/or precipitation. Calculated surface runoff was then used as input for the groundwater model which calculates streambed percolation based on streamflow, streambed parameters (i.e., hydraulic conductivity), stream stage, and groundwater elevations underlying the stream channels.

While the San Luis Rey River is the main surface water feature in the subbasin, the majority of flow is captured by Henshaw Dam (owned and operated by Vista Irrigation District (VID)), forming Lake Henshaw. Lake Henshaw is also augmented in dry years with groundwater from Warner Valley. Spills over the dam have only occurred a couple of times since the construction of the dam, and only during extremely wet weather events (Stetson, 1984). Releases from the dam are primarily diverted into the Escondido Canal, where it is transported approximately 14 miles to Lake Wohlford. The water is then treated at the Escondido-Vista Treatment Plant and delivered to VID and City of Escondido service areas. Surface water deliveries are also made from the Escondido Canal to the Rincon Reservation. These deliveries were historically made to a retired penstock on the Rincon Reservation and occasionally released in Hellhole Canyon. Currently, surface water is released near the Escondido diversion dam and flows down the canyon to the reservation.

Surface water that is not able to be captured at the Escondido Canal diversion structure, which has a diversion capacity of 50 cfs, continues downstream into Pauma Valley. These flows typically occur during storm events when flow quantities and water quality (i.e., abundance of suspended sediments in flow) are above diversion abilities or suitability, or when storage is limited in Lake Wohlford. Several entities within the USLR Valley Groundwater Subbasin hold active surface water diversion rights, which are available to view on the Electronic Water Rights Information Management System (eWRIMS)[15].

3.3.3.1.4 Return Flow from Applied Water

Water applied at the surface can become runoff (if applied in excess of infiltration capacity or irrigation requirements) or can be consumed by evapotranspiration (ET). In addition, it can become groundwater recharge through deep percolation. Return flow refers to the amount of water that returns to the aquifer after application of water to the land surface in the form of irrigation, leaks in water lines, or septic seepage. This includes the use of groundwater, surface water, and imported water.

The use of imported water in the basin has increased since imported water deliveries began in 1947 with the completion of the first San Diego Aqueduct (Recon, 1996). Within the USLR Valley Groundwater Subbasin, YMWD receives imported water through Metropolitan Water District of Southern California (Metropolitan) and the San Diego County Water Authority (Water Authority). YMWD is served off the First Aqueduct, Pipeline No. 1, near Couser Canyon Road in Valley Center just north of Lilac Tunnel (see Figure 3-1) and receives treated water from Lake Skinner (see Plan Area, Section 2.1.2.3 for additional information). During the period from 1991 through 2020, YMWD imported water deliveries averaged approximately 2,800 acre-ft/yr. Over the last five years (i.e., 2016 through 2020), average deliveries have been closer to 4,700 acre-ft/yr.

As mentioned in the previous section, surface water diversion rights are held by several entities in the USLR Valley Groundwater Subbasin. These surface water diversions are typically used to augment irrigation supply. In addition, surface water deliveries from the Henshaw Dam are made to the Rincon Indian Reservation, which has retained vested water rights in this surface water.

Return flow also includes water from septic system seepage. The majority of residential lots are on septic systems and a substantial portion of domestic water is used indoors. This water is then recharged back into the groundwater system via the septic system. Regional Water Board modeling in 1987 indicated that 90 to 99 percent of leachate from septic systems reaches the water table as return flow (County, 2010).

3.3.3.1.5 Recycled Water Spreading

Sewage disposal in the Plan Area is primarily accomplished through septic tanks. One sewage treatment plant is operated by Pauma Valley CSD within Pauma Subbasin, which has discharged wastewater to percolation ponds since 1963 (Moreland, 1974; PVCSD, 2015). The percolation of treated effluent from the Pauma Valley Treatment Plant is covered under CA Regional Water Quality Control Board Order No. R9-2006-0049 and averages approximately 75,000 gpd (NBS/Lowry, Inc., 1991; LAFCO, 2013). Additional recycled water spreading takes place in Pala Subbasin (servicing a portion of the Pala reservation) and at the Pauma Casino.

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15 Diversion information available at: https://www.waterboards.ca.gov/waterrights/water_issues/programs/ewrims/

3.3.3.2 Groundwater Discharge

3.3.3.2.1 Groundwater Pumping

Groundwater pumping represents the primary source of discharge from the USLR Valley Groundwater Subbasin. Pumping records were requested from basin stakeholders as part of the GSP effort and were received from many of the water purveyors in the basin and several large agricultural entities. The remaining unreported groundwater pumping was estimated to be water use not met by reported pumping, based on land use and crop type/coverage through time obtained from the County Department of Planning and Land Use (County, 2010) or other estimates of water use from previous studies. This estimation is discussed in further detail in Section 3.3.5 (Water Budget Information).

Preliminary estimates of groundwater pumping presented in this version of the GSP provide a general estimate of sustainable yield for the subbasin. Since additional information is anticipated to be collected throughout the subbasin following GSP implementation, pumping and therefore sustainable yield estimates can continue to be refined to provide the best estimate based on available information (see Section 3.3.5.8 for additional discussion). Based on current information, groundwater pumping in the entire USLR Valley Groundwater Subbasin – including Pauma and Pala Subbasins – over the period from 1991 through 2020 was estimated to average approximately 14,000 acre-ft/yr, including 8,000 acre-ft/yr in reported pumping (primarily in Pauma Subbasin) and 6,000 acre-ft/yr in unreported pumping. These estimates were refined through model calibration since the model calibration process provides an indication of the appropriateness of water budget terms based on the ability of model to match observed water level elevations.

3.3.3.2.2 Rising Water Discharge to Surface Flow and Subsurface Outflow

A stream gains or loses water depending on the relative head (water elevation) in the stream and in the underlying aquifer. When the head in the stream is higher than the head in the aquifer, the stream loses water to the aquifer; when the head in the stream is lower than the head in the aquifer, the stream gains water from the aquifer. In natural systems, the amount of rising water fluctuates depending on groundwater elevations relative to stream stage.

Rising water occurs as groundwater gradients push groundwater to the surface at topographic lows or geologic contacts. Groundwater becomes surface water outflow when it reaches the land surface. In the USLR Valley Groundwater Subbasin, the main area of rising water is at and before the Monserate Narrows, at the end of Pala Subbasin. Here, shallow bedrock elevations force groundwater to the surface where it becomes streamflow. Two United States Geological Survey (USGS) streamflow gaging stations are located at the bottom of Pala Subbasin (11040000 and 11039800), in the Monserate Narrows area, which provide information about surface flow leaving the USLR Valley Groundwater Subbasin. Shallow basement rock and the encroachment of the Agua Tibia Fan on the San Luis Rey River also forces groundwater to the surface near Frey Creek, at the downgradient boundary of Pauma Subbasin. Rising water conditions at this location were historically observed year-round, even during drought events (DWR, 1965).

Groundwater underflow outflow to Bonsall Subbasin also occurs in the river sediments running through the Monserate Narrows. Underflow outflow was estimated by Ellis and Lee (1919) to be approximately 340 acre-ft/yr using Darcy's equation. Moreland (1974) estimated underflow outflow from Pala Subbasin at Monserate Narrows to be approximately 250 to 480 acre-ft/yr.

3.3.3.2.3 Evapotranspiration

ET includes the consumption of surface and groundwater through evaporation and transpiration by plants. In general, groundwater ET decreases with decreasing groundwater elevation and is the highest in areas where groundwater level elevations approach or exceed the ground surface. In areas of shallow groundwater, brush and trees along the river (phreatophytes) can derive water directly from the subsurface. Moreland (1974) estimated ET from riparian vegetation to be approximately 1 to 1.4 acre-ft/acre when water table is 10-30 ft bgs and 2 acre-ft/acre when the water table is less than 10 ft bgs. Muckel and Blaney (1945) estimated the consumptive use of native vegetation in the San Luis Rey Valley Groundwater Basin to range from 1.3 to 4.6 ft.

3.3.4 Current and Historical Groundwater Conditions

3.3.4.1 Groundwater Elevations

Groundwater recharge in the USLR Valley Groundwater Subbasin can be highly variable year-to-year, depending on the amount of rainfall the area experiences. During dry periods (below average rainfall), groundwater pumping can cause temporary declines in groundwater levels which tend to recover during wet periods (Stetson, 1984). This causes groundwater elevations in the Plan Area to fluctuate seasonally and annually in response to groundwater stresses (such as pumping) and recharge from precipitation events. The highest groundwater levels are typically observed in March before regional pumping increases and are lowest in late fall (November) before seasonal rainfall/recharge events (Geosyntec, 2015). In addition, the aquifer responds fairly quickly to groundwater stresses and replenishment due to higher hydraulic conductivity (Born, Barrett & Associates, 1985). Therefore, the rapid recovery of groundwater levels has been observed during recharge events (DWR, 1965).

Contours of groundwater elevation were developed based on observed water level data[16]. Data were received from basin stakeholders or obtained through State databases, such as the California Statewide Groundwater Elevation Monitoring (CASGEM) Program database. Information received from various entities was reviewed to identify any anomalies. Some datasets were not able to be used due to uncertainty (e.g., obvious transducer drift, etc.). As discussed in the Plan Area section (Section 2.2.1.1), DWR developed the CASGEM Monitoring Program in 2009 to establish a permanent, locally managed program of routine groundwater monitoring to track seasonal and long-term groundwater elevation trends in all of California's alluvial groundwater basins. Within the San Luis Rey Valley Groundwater Basin, the County of San Diego represents the sole Monitoring Entity, with some water districts participating as contributing agencies (including YMWD). CASGEM wells within the USLR Valley Groundwater Subbasin include YMWD 21a (southeastern, upper portion of Pauma Subbasin), YMWD PVW2 (lower portion of Pauma Subbasin), Wilderness Gardens WG-1 (upper portion of Pala Subbasin), and State Well 10S02W06F002S (lower portion of Pala Subbasin). All of these wells focus on the upper alluvial aquifer. Groundwater contours for 1991 (representing the start of the period that was used to develop historical

[16] Note: well screen information is unavailable for many of the wells with observed water levels. This represents a data gap for which information will be requested through the well inventory management program (see Section 6.2.2).

water budgets – see Section 3.3.5.5) and 2020 (representing current water levels) are shown on Figures 3-11 and 3-12.

The groundwater elevation contours represent lines of equal elevation on the groundwater surface. Groundwater flow occurs perpendicular (i.e., at 90°) to the elevation contours. Both contour figures show similar patterns for groundwater flow. In the upgradient portion of the subbasin (southeastern area of Pauma Subbasin), groundwater generally flows to the west and southwest down the alluvial fans towards the axis of the valley. Groundwater flow then starts to bend to the north through Pauma Subbasin and into Pala Subbasin, following the direction of surface water flow. In Pala Subbasin, groundwater generally flows west – again, following the direction of flow in the San Luis Rey River and the general topography in the subbasin. As also indicated by the figures, there are few available water level data in Pala Subbasin to constrain water level contours. The need for additional potential water level and water quality monitoring in this subbasin is discussed in the monitoring network section of this GSP (Section 5.0).

Depth to groundwater contours are shown on Figure 3-13 These contours were developed by subtracting the contoured groundwater elevations from the ground surface elevation.

Hydrographs showing water level measurements through time were also assembled from available information. Selected hydrographs in Pauma and Pala Subbasins are shown on Figures 3-14 and 3-15, respectively. Hydrographs were selected primarily based on data record (many of the wells only had a handful of measurements and did not provide a good indication of water level change through time) and in order to provide a good representation of water levels throughout the subbasin. As shown on the figures, many of the wells – particularly in Pauma Subbasin where records are more extensive – indicate declining groundwater levels in earlier time periods, such as the late 1980s through the early 1990s. According to the cumulative departure from mean annual precipitation, this time period generally coincided with wet and average hydrologic conditions (Figure 3-2). Therefore, these water levels likely indicate the increase in agricultural production in the area at a time when imported water deliveries to the subbasin were still relatively small (approximately 1,400 acre-ft/yr from 1990 to 2000). While less data are available in the Pala Subbasin, the Barona Tribal Authority reported historical low groundwater levels at certain wells in the late 1990s and early 2000s (County, 2010). Declines in water levels were also observed in the 1940s and 1950s (Howes, 1955). Declines in groundwater levels are also typically more pronounced in the alluvial fan areas of the subbasin and tend to be more consistent along the axis of the valleys.

Starting in the early 2000s, water level elevations generally begin to respond more to the hydrologic cycles observed in the cumulative departure graph (i.e., groundwater elevations stabilize under average hydrologic conditions, increase under wet hydrologic conditions, and decrease when hydrologic conditions are dry). In the last five to ten years in particular, groundwater levels in many parts of the subbasin show recovery. This coincides with average to wet hydrologic conditions and the increased use of imported water (averaging approximately 3,800 acre-ft/yr over the last 10 years).

Therefore, following a period of decline averaging approximately 1 to 4 ft/yr over the last 30 years, groundwater levels in the USLR Groundwater Subbasin appear to have become fairly balanced over the last 10 years or so. In addition, many wells show recent recovery – likely due to a stabilization in land use and the increasing use of supplemental water through imported water deliveries.

3.3.4.2 Groundwater Storage

Groundwater storage is computed as the volume of groundwater in a given basin from the basement of the aquifer (i.e., bedrock surface) to a given reference point. This reference point could be ground surface (representing total maximum amount of groundwater storage assuming the basin could be filled to saturation) or a defined groundwater elevation (e.g., spring high, fall low, or specified target groundwater elevation). Previous estimates of groundwater storage in the USLR Valley Groundwater Subbasin are summarized in Table 3-1 below.

For the current analysis, groundwater storage was computed from the top of bedrock surface (i.e., bottom of the aquifer) to the top of the current water table, using initial specific yield and specific storage values from the USGS salt balance model developed for the subbasin (Moreland, 1974). These storage coefficients range from 0.09 to 0.12. Historical water level contours for 1991 and current water level contours for 2020 are provided as Figures 3-11 and 3-12, respectively. As shown on the figures, water level control points are fairly scarce and generally located near in the center portions of the subbasin. Therefore, uncertainty tends to increase around the margins of the subbasin where control is more limited. Calibration of the groundwater model provides a little more confidence in these areas as aquifer parameters are refined to produce water levels that match observed measurements throughout the subbasin for all times included in the model calibration period.

Based on contoured groundwater elevations and storage parameters from the USGS model, groundwater storage in the USLR Valley Groundwater Subbasin in 1991 is estimated to be approximately 184,000 acre-ft while current groundwater in storage is approximately 124,000 acre-ft. These estimates are generally in line with previous estimates of storage for the subbasin (see table below).

Table 3-1. Previous Estimates of Groundwater Storage for the Upper San Luis Rey Valley Groundwater Subbasin

Source	Pauma Subbasin	Pala Subbasin [acre-ft]	Total Upper San Luis Rey Valley
Stetson (1984)	107,000 – 140,000	41,000 – 53,000	148,000 – 193,000
Layne (2010)	42,880 – 125,561	-	-
GSP (2021)	-	-	124,000 – 184,000

3.3.4.3 Groundwater Quality

Most common water quality contaminants in San Diego County include elevated nitrate, naturally occurring radionuclides, total dissolved solids (TDS), and bacteria. Most common sources of anthropogenic contamination include leaking underground fuel tanks, sewer and septic systems, agricultural applications, and facilities with excess animal waste.

Groundwater quality in the USLR Valley Groundwater Subbasin is typically calcium-sodium bicarbonate (Stetson, 1984). The general water chemistry is likely influenced by water moving along the Elsinore fault zone, which is thought to contribute large quantities of gypsum to the groundwater system (Vaughan, 1987). Quality is also strongly influenced by surface water in the San Luis Rey River and return flows from imported water and groundwater applied to the surface for irrigation (Stetson, 1984).

Surface water of the San Luis Rey River is generally good but of variable quality. Surface water brings natural salts from upstream areas into the basin area where it can infiltrate into the subsurface (Stetson, 1984). TDS in surface water between Lake Henshaw and the Monserate Narrows typically ranges from 200 to just over 400 mg/L, with increases generally observed during dry periods (Stetson, 1984). TDS concentrations also tend to increase downstream (DWR, 1965). The water quality of surface water released from Lake Henshaw also depends on the amount of time the water was stored behind the dam due to effects from evapotranspiration. In addition, wet precipitation events provide a large influx of high-quality water, diluting groundwater in storage that is higher in TDS (DWR, 1965). There is a concern that reduced natural recharge from upgradient diversions may lead to a slow increase in TDS over time (Stetson, 1984).

Applied water at the surface can leach chemicals and minerals in the unsaturated vadose zone and transport them to the underlying aquifer system. There is a tendency in groundwater basins towards the general degradation of groundwater quality through time due to irrigation and septic return flows, use of imported water, and evapotranspiration (DWR, 1965). This is an important concern for the USLR Valley Groundwater Subbasin, since groundwater quality (particularly TDS concentrations) can affect agricultural yields.

The Porter-Cologne Water Quality Control Act (California Water Code, Division 7, Chapter 2) requires that beneficial uses and water quality objectives be established for both surface and groundwaters of the State. The establishment of beneficial uses and water quality objectives for surface water is also mandated by the federal Clean Water Act (33 USC). The California Water Code defines water quality objectives as:

> *"The limits or levels of water quality constituents or characteristics which are established for the reasonable protection of beneficial uses of water or the prevention of nuisance within a specific area".*

According to the Basin Plan (Regional Board, 1994), beneficial use is defined as

> *"the uses of water necessary for the survival or wellbeing of man, plants, and wildlife. These uses of water serve to promote the tangible and intangible economic, social, and environmental goals of mankind".*

In the Plan Area, beneficial use includes municipal and domestic supply, agricultural supply, industrial service supply, water recreation, and the support of freshwater and wildlife habitat (including habitat for rare, threatened or endangered species). The Basin Plan's water quality objectives are numerical limits designed to protect the beneficial uses designated for the water body (surface or groundwater). TDS and nitrate groundwater objectives for the USLR Valley Groundwater Subbasin are summarized below (Regional Board, 1994):

Table 3-2. Groundwater Quality Objectives

Hydrologic Subarea	TDS	Nitrate (NO_3)
	[mg/L]	
Pauma Subbasin	800	45
Pala Subbasin	900	45

Notes:
[1] Concentrations not to be exceeded more than 10% of the time during any one year period.
[2] The Basin Plan allows for measurable degradation of groundwater in this basin to permit continued agricultural land use. Point sources, however, would be controlled to achieve effluent quality corresponding to the tabulated numerical values. In future years demineralization may be used to treat groundwater to the desired quality prior to use.

Ambient groundwater quality in the basin was evaluated by taking median concentration of average water quality in wells with at least three water quality readings from 2015 through 2020. Well locations with available datasets during this period are shown on Figure 3-16. The median was chosen as a representative value of overall basin water quality because medians can be reliably calculated for datasets with mixed censored and non-censored data (detects and non-detects), allow for the use of an entire water quality dataset while minimizing the skewing effect of potential data outliers, and do not rely on parametric statistical methods that assume normal data distribution to remove potential outliers. As shown on Figure 3-16, no wells in the Pala Subbasin met the criteria of having at least three water quality readings in the last six years. Therefore, ambient concentrations in this area were not able to be determined.

3.3.4.3.1 Total Dissolved Solids

TDS is a measure of salinity which accounts for all dissolved solids in water (as milligrams per liter [mg/L]) including organic and suspended solids and is commonly analyzed to determine general suitability for human consumption. A TDS concentration of 500 mg/L is the secondary standard for drinking water established by the U.S. EPA and State Water Resources Control Board. A TDS of greater than 1,000 mg/L is generally considered to be brackish water and not suitable as a potable supply without treatment or blending. As shown above, the groundwater quality objectives for TDS in the Pauma and Pala Subbasins are 800 and 900 mg/L, respectively.

Natural sources of TDS include interaction of groundwater with the soil, rock, and organic matter which compose an aquifer system. Human activities such as irrigation and agricultural practices which include application of synthetic fertilizers and manure are a common source of TDS. Also, effluent from wastewater treatment facilities and septic systems and other industrial processes, as well as the use of imported water which tends to be higher in TDS than many groundwaters, can contribute to elevated TDS concentrations in water.

TDS concentrations in the USLR Valley Groundwater Subbasin were evaluated based on available water quality data and recent groundwater quality sampling as part of the initial GSP monitoring network to establish a baseline for groundwater conditions (see Section 3.3.4.3.3). Historical TDS concentrations are shown on Figure 3-17 while TDS concentrations from the Spring 2021 water quality sampling event are shown on Figure 3-18. Historically, TDS in the subbasin ranges from 19.6 mg/L to 1,950 mg/L (Figure 3-17). Current TDS samples indicate concentrations ranging from 120 mg/L to 1,400 mg/L (Figure 3-18).

It is important to note that continuous water quality records within the subbasin are very limited. Recent data (within the last 10 years) is really only available in the Pauma Subbasin. The majority of historical data points shown on Figure 3-17 (from the California Division of Drinking Water's (DDW's) water quality databases) – particularly those in Pala Subbasin and areas overlying reservation lands – represent older records which may not reflect current conditions. Groundwater sampling during GSP development, which provide the most recent water quality data, took place primarily in the Pauma Subbasin and upper portion of Pala Subbasin based on access to wells (refer to Section 3.3.4.3.3 for additional discussion).

3.3.4.3.2 Nitrate

Nitrate is commonly associated with the industrial process of manufacturing synthetic fertilizers and with agricultural activities, septic systems, confined animal facilities, and wastewater treatment facilities. However, nitrate in water can also be naturally occurring. Nitrate in drinking water is a health concern to both humans and animals, and the State has established an MCL of 10 mg/L for nitrate as nitrogen (N). The State's Public Health Goal (PHG) for nitrate as NO_3 is 45 mg/L (SWRCB, 2020).

Figures 3-19 and 3-20 show the distribution of nitrate (as N) in the USLR Valley Groundwater Subbasin historically and based on the Spring 2021 water quality sampling event, respectively. Historically, nitrate (as N) in the subbasin ranges from 0.02 mg/L to 29.4 mg/L (Figure 19). Current samples indicate nitrate (as N) concentrations ranging from 1.6 mg/L to 32 mg/L (Figure 20). However, as with the TDS samples, nitrate data is very limited historically while current water quality sampling was limited primarily to Pauma Subbasin due to well access restrictions.

3.3.4.3.3 Initial Monitoring Network – Water Quality Sampling

As part of the GSP effort, an initial monitoring network was established to provide a good foundation for characterizing current groundwater conditions and which could be used for future, on-going monitoring after GSP implementation. The wells selected to be monitored during the GSP development process are shown on Figure 3-21. These wells were selected based on available data, geographic and vertical distribution, and willingness of the well owner to participate in the GSP monitoring effort. Where good well coverage was available, selected monitoring locations were determined based primarily on available data (wells with greater historical data coverage were prioritized over wells with less or no available information) in order to take advantage of the historical data record.

Groundwater quality samples were taken semiannually during the GSP development to provide a representation of current ambient groundwater conditions in the basin in spring and fall. After implementation of the GSP, select wells from the monitoring network will also provide representative data to evaluate GSP sustainability indicators, including groundwater levels, groundwater storage, water quality, and depletions in interconnected surface water, in accordance with the specific sustainability goals established by the GSA (Section 4.0). Future monitoring of these sustainability indicators, as well as additional discussion and recommendations for the monitoring network, is provided in the monitoring network section of the GSP (Section 5.0).

The first groundwater quality sampling event took place on March 24, 25, and 29, 2021. Depth-to-groundwater measurements were taken in all the monitoring wells using a water level meter with a manufacturer's reported accuracy of 0.01 foot. At the time of purging and sampling, each of the wells except MW19 and MW30 had been pumping for a period of at least several hours.

The selected monitoring wells sampled consist of existing operable wells with dedicated pumps. During purging, water was poured into a flow-through cell and calibrated water quality meter (YSI ProDSS) capable of measuring pH, dissolved oxygen, conductivity, salinity, total dissolved solids, temperature, turbidity, and oxidation/reduction potential. The water quality meter probe and associated flow-through cell interior were rinsed but not decontaminated between wells due to samples being collected directly from the well sample ports. Water quality measurements were recorded approximately every 5 minutes as the wells were pumping. Generally, the wells were sampled after approximately 15 minutes of pumping. Samples were collected directly into appropriate laboratory-supplied containers.

Well MW30 could not be sampled from the well head so a water sample representing this location was collected from the nearby water tank that receives water from MW30 among others. As such this sample represents a composite of several wells, including a well completed in bedrock. The sample was collected from a valve on the discharge pipe from the storage tank.

Each sample was labeled and placed in an ice-packed cooler for transport under chain-of-custody to the laboratory for analysis. The groundwater sampling data sheets were reviewed by a state of California-certified Professional Hydrogeologist and are provided in Appendix 3b while sampling results are summarized in attached Table 3-13.

A similar sampling event occurred in Fall 2021, on October 12, 13, and 14. Results from this sampling event are also included in Appendix 3b and Table 3-13.

3.3.4.4 Interconnected Surface Water Systems

Given the depth to groundwater in much of the basin, percolation from streamflow is thought to be largely in free fall conditions; that is, the streams are not in direct hydraulic connection with the underlying water table and aquifer system so that surface recharge must percolate through the unsaturated zone before becoming accessible to groundwater pumping. This is especially true for tributaries to the San Luis Rey River (e.g., stream channels crossing alluvial fans). While there are areas within the basin where groundwater has been known to enter the San Luis Rey River (such as in the downgradient Pala Subbasin area where there is standing water), not enough stream flow or groundwater level information near stream channels is available to definitively delineate gaining or losing stream reaches – that is, where streams are interconnected or disconnected from underlying groundwater. This has been identified as a data gap area and additional data collection following GSP implementation will help to develop a better understanding of interconnected surface waters in the basin.

For the purposes of GSP development, the Nature Conservancy has suggested using a depth to groundwater threshold of 50 ft to identify stream reaches that could potentially be interconnected with groundwater. Areas where estimated groundwater is within 50 ft of ground surface are also denoted on Figure 3-22. However, available groundwater hydrographs in the basin near the river suggest that seasonal fluctuations are typically around 20 to 30 ft in these wells, which may be a better threshold indicator of interconnectivity. In addition, estimates of groundwater elevations and corresponding depth to groundwater are based on limited observations. Therefore, the interconnectivity of surface water and groundwater systems will need to be evaluated as additional information becomes available through increased monitoring and data collection.

3.3.4.5 Groundwater Dependent Ecosystems

Henshaw Dam was constructed in 1922 by VID to provide water for domestic and agricultural uses. Water is released from the dam into the natural stream channel and then diverted approximately 10 miles downstream into the Escondido Canal, which is located upgradient of the USLR Valley Groundwater Subbasin. Prior to construction of the dam, the San Luis Rey River in the vicinity of Henshaw Dam was perennial, with minimum flows above 1.4 cfs (Case Study Report #76). Continuous flow was also observed in the San Luis Rey River at Pala from 1903 through 1915 (Ellis and Lee, 1919).

The California Department of Fish and Game reported that riparian vegetation adjacent to the river may have historically supported large populations of wildlife, but no records of fish and wildlife existing in the river prior to dam construction were found in the Department of Fish and Game files (Case Study Report #76). Sensitive species identified by the Nature Conservancy and California Department of Fish and Wildlife as potentially being present within the USLR Valley Groundwater Subbasin are summarized in the following table. However, not enough information is currently known to verify their presence in the subbasin or assess their reliance on potential GDEs and/or interconnected surface waters. Therefore, impacts of groundwater management in the subbasin on wildlife habitat may need to be revisited as additional information becomes available. Discussion to this effect will be included in the 5-year report as needed.

Table 3-3. Sensitive Wildlife Species Potentially Present within the Subbasin

Scientific Name	Common Name	Legal Protected Status	
		Federal	State
Actinemys marmorata	Western Pond Turtle		Special Concern
Agelaius tricolor	Tricolored Blackbird	Bird of Conservation Concern	Special Concern
Anaxyrus californicus	Arroyo Toad	Endangered	Special Concern
Anniella pulchra	California Legless Lizard		Special Concern
Arizona elegans occidentalis	California Glossy Snake		Special Concern
Buteo swainsoni	Swainson's Hawk		Endangered
Coccyzus americanus occidentalis	Western Yellow-Billed Cuckoo	Candidate - Threatened	Endangered
Empidonax traillii extimus	Southwestern Willow Flycatcher	Endangered	Endangered
Gelochelidon nilotica vanrossemi	Gull-Billed Tern	Bird of Conservation Concern	Special Concern
Gila orcuttii	Arroyo Chub		Special Concern
Icteria virens	Yellow-Breasted Chat		Special Concern

Scientific Name	Common Name	Legal Protected Status	
		Federal	State
Oncorhynchus mykiss	Southern California Steelhead	Endangered	
Pelecanus erythrorhynchos	American White Pelican		Special Concern
Phrynosoma blainvilli	Coast Horned Lizard		Special Concern
Rana draytonii	California Red-Legged Frog	Threatened	Special Concern
Setophaga petechia brewsteri	A Yellow Warbler	Bird of Conservation Concern	Special Concern
Spea hammondii	Western Spadefoot	Under Review in the Candidate or Petition Process	Special Concern
Thamnophis hammondii	Two-striped Gartersnake		Special Concern
Thamnophis sirtalis ssp. 1	South Coast Gartersnake		Special Concern
Vireo bellii pusillus	Least Bell's Vireo	Endangered	Endangered

Since construction of the dam, flows between the dam and Escondido Canal are likely insufficient to support fishery habitat (Case Study Report #76). As mentioned in the Plan Area section, the USLRRCD has several conservation easements for Arroyo Toads in the USLR Valley Groundwater Subbasin, but these habitat areas are primarily dependent on seasonal surface water and the vernal pools created after storm events and do not appear to be maintained by shallow groundwater. The PVGSA is unaware of any managed wetlands within the subbasin.

Helix Environmental conducted a desktop study to assess the possibility of groundwater dependent ecosystems (GDEs) in the USLR Valley Groundwater Subbasin. Sources of information included recent and historical aerial imagery, National Wetlands Inventory (NWI) mapping, San Diego Association of Governments (SANDAG) regional vegetation mapping, topographic mapping, and other pertinent biological resources data. A summary of their investigation is provided as Appendix 3c.

Based on this analysis, areas of potentially groundwater dependent vegetation were identified but have not been verified through field investigation. As shown on Figures 3-23 and 3-24 for Pauma and Pala Subbasins, respectively, the potential groundwater dependent vegetation communities are typically located along the San Luis Rey River and tributary drainages, though many drainages were considered to be too incised or located in too steep of topography to support groundwater dependent vegetation. The vegetation communities include:

- Southern Riparian Forest
- Southern Coast Live Oak Riparian Forest
- Southern Arroyo Willow Riparian Forest
- Southern Cottonwood-Willow Riparian Forest
- Southern Riparian Woodland

- Southern Sycamore-Alder Riparian Woodland
- Southern Riparian Scrub
- Mule Fat Scrub
- Southern Willow Scrub
- Freshwater Riparian
- Non-Native Riparian

These vegetation areas identified as being potentially dependent on groundwater are not necessarily GDEs. Instead, the vegetation areas shown on Figures 3-23 and 3-24 may be relying on ambient soil moisture (not considered part of the interconnected groundwater system) and seasonal rainfall/surface flow. Also, as mentioned in the hydrogeologic conceptual model, water traveling within bedrock fractures and fault splays (not part of the USLR Valley Groundwater Subbasin) may be intercepted by transecting creeks, thereby becoming available to riparian vegetation.

Figure 3-25 shows vegetation areas located within areas estimated by the groundwater model (see Section 3.3.5.1) to have groundwater within 30 ft of land surface. This depth is recommended by the Nature Conservancy as a threshold by which to identify areas where potential GDEs are accessing groundwater. Guidance from a USGS technical report (Maddock et al., 2012) applicable to the southwest considers 20 ft below ground surface to be the typical extinction depth for most deep-rooted riparian vegetation. That is, most roots of riparian vegetation would not be able to access groundwater resources if groundwater levels were deeper than this threshold. This 20-ft threshold is therefore also indicated on Figure 3-25. However, as noted previously, these areas (and their groundwater dependency) need to be evaluated by field investigation and through the collection of additional data. Therefore, they are being retained here as potential GDEs until further information is available through the management actions to address data gap areas (see Section 6.0).

3.3.4.6 Seawater Intrusion

As discussed in the Plan Area section (Section 2.4.1), seawater intrusion is typically observed in groundwater basins in closer proximity to the coast (e.g., downstream reaches of the Lower San Luis Rey Valley Groundwater Subbasin[17]), where lowering of groundwater levels from pumping can reverse the groundwater flow gradient and allow ocean water to flow inland to lower groundwater elevations. Given the distance of the USLR Valley Groundwater Subbasin from the coast, the possibility of seawater intrusion from the ocean is not considered a threat.

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[17] The neighboring Lower San Luis Rey Valley Groundwater Subbasin has had historical issues with seawater intrusion (prior to the 1960s), between two to six miles inland from the Pacific Coast. Imported water deliveries have since allowed groundwater levels to recover enough to maintain groundwater gradients and limit seawater intrusion (SDIRWM, 2020). Current salinity values are still measuring high in the Lower San Luis Rey Valley Groundwater Subbasin, possibly from a combination of salt loading from storm water and irrigation flows and historical seawater intrusion effects (City of Oceanside et al., 2008). Maintaining control of saline water intrusion is requirement in the Oceanside Narrows through use of minimum threshold groundwater elevations designed to maintain a seaward groundwater gradient in the Mission Basin.

3.3.4.7 Land Subsidence Conditions

Land subsidence due to groundwater withdrawal is a long-term, gradual phenomenon that can have lasting effects, even after cessation of pumping. Subsidence from groundwater pumping has been well documented historically in other locations of California and the United States (e.g., Johnson et al., 1968; Meade, 1968; Ireland et al., 1984; and Poland and Ireland, 1988) and is typically associated with:

- Aquifers having a high percentage of fine-grained interbedded materials, which are normally consolidated.
- High rates of sustained pumping which cause long-term (e.g., decades) declines on groundwater levels ranging from 100 to 200 ft.

Typically, subsidence occurs as the result of the compaction of fine-grained confining beds (e.g., clays) due to dewatering of the sediment pores from excessive pumping or groundwater withdrawal. This causes the clay to compress, or compact, resulting in the lowering of the overlying land surface. The amount of compaction an aquifer may experience is a function of the compressibility of sediments within the range of change in applied stress (i.e., change in water level) as well as the magnitude of the change in stress, which is characterized by Terzaghi's Theory of Consolidation. Compaction is also dependent on the thickness of interbedded clay layers and the length of time declines in water levels have been experienced or observed.

Thick, interbedded layers of clay necessary for land subsidence have not been observed in the USLR Valley Groundwater Subbasin. The only significant accumulation of fine-grained sediments are those from paleo Lake Pauma, which have a maximum thickness of about 10 ft and are not continuous throughout the entire basin. Substantial long-term declines in groundwater elevations have also not been observed, nor have there been any accounts of historical land subsidence or features associated with subsidence (e.g., ground fissuring). Therefore, subsidence potential in the USLR Valley Groundwater Subbasin is considered to be a very low risk.

3.3.5 Water Budget Information (§354.18)

A water budget is an accounting of all water that flows into and out of a specified area (i.e., recharge and discharge), including any resulting water storage change. This may be expressed through the Equation of Hydrologic Equilibrium, which is essentially a statement of the Conservation of Mass relating inflow, outflow, and change in groundwater storage:

Inflow = Outflow +/- Change in Groundwater Storage

The geohydrologic conceptual model presented above indicates that the Pauma and Pala Subbasins are hydrologically connected and were essentially formed through the same geologic processes. Therefore, water budgets were established for both subbasins using a calibrated model of the USLR Valley Groundwater Subbasin.

3.3.5.1 Upper San Luis Rey Groundwater Model (USLRGM)

During development of this GSP, the USLR Groundwater Model (USLRGM) was developed and calibrated for the unconsolidated sediments of Pauma and Pala Subbasins. It consists of an integrated surface water and three-layer groundwater model that was calibrated to observed surface water flow and groundwater elevations for the period from 1991 through 2020 (Figure 3-26).

The watershed modeling component uses the modeling code Hydrologic Simulation Program – Fortran (HSPF). HSPF is a successor to the FORTRAN version of the Stanford Watershed Model (SWM). The SWM evolved over the period from approximately 1956 through 1966. Work in 1974 resulted in the widely available codes developed for and with support of the EPA. HSPF is a comprehensive and physically based watershed model that can simulate water cycle components with a time step of less than one day. The watershed model is calibrated to observed streamflow at available USGS gaging station locations.

The groundwater modeling component was constructed using MODFLOW, a block-centered, modular finite difference groundwater flow code. Widely used and highly versatile, it was developed by the USGS (McDonald and Harbaugh, 1988) for the purpose of modeling both saturated and unsaturated groundwater flow. Specifically, the Newton formulation of the MODFLOW-2005 computer code, known as MODFLOW-NWT, was used for the USLRGM. The Newton-Raphson solver included in the MODFLOW-NWT code is well suited for solving problems involving drying and rewetting nonlinearities of the unconfined groundwater flow equation (Niswonger et al., 2011). The input data for the groundwater model was based on a monthly basis (i.e., monthly stress periods) from January 1991 through December 2020. The monthly stress periods provide the ability to model the seasonal aspects of fluxes such as areal recharge, return flow, pumping, mountain front runoff, and streambed percolation. The groundwater model is calibrated to observed groundwater elevations throughout the subbasin. Boundary conditions used to simulate inflow and outflow terms in the groundwater model are shown on Figure 3-27.

Model calibration is performed to improve the accuracy of the model in simulating observed groundwater levels. The method used to calibrate the USLRGM was the industry standard “history matching” technique in which hydrogeologic parameters are manually varied until the best fit is achieved for transient conditions. These parameters included horizontal and vertical hydraulic conductivities, specific yield, model general head boundaries, and streambed conductance. The USLRGM was calibrated for the period January 1991 through December 2020. Model-simulated water levels generally provide a good match with measured water levels and follow observed trends.

Additional information and discussion regarding the development of the surface water and groundwater components of the USLRGM is provided in the modeling documentation as Appendix 3d. While this model provides a solid approach for evaluating groundwater budgets and individual recharge and discharge terms, it also represents a tool that can be used for future basin management, such as providing projections of groundwater impacts and the evaluation of proposed projects to meet groundwater sustainability goals. However, the model represents a simplified approximation of complex hydrogeologic systems and was designed with certain built-in assumptions. The accuracy of the predictions made by the integrated model is highly dependent on the simplifying assumptions used. In addition, the modeling results are not absolutes, but are indications that will need to be confirmed by actual operations, monitoring and refinement through an adaptive management process.

A reliable watershed or groundwater model depends upon accurate and abundant sources of measured data and a satisfactory calibration and/or validation period. Often, in absence of complete or accurate records, model input represents estimated and/or averaged values. Future use of an extended data set and calibration period should continue to improve the accuracy and reliability of the model.

3.3.5.2 Groundwater Inflows

Water budget terms were based on the hydrogeologic conceptual model presented above for groundwater recharge and discharge. The general modeling approaches taken to estimate each groundwater inflow term through time based on measured data and/or the development of scientific assumptions are summarized below.

3.3.5.2.1 Recharge from Mountain Front Runoff

Recharge from mountain front runoff was estimated by the surface water model based on precipitation (see next section), potential ET, soil type/coverage, land use, topography/slope, and other hydrologic properties. A discussion of the data used for the watershed model is included in Appendix 3d. Interception of recharge through surface water diversions and pumping outside of the groundwater basin (but within the watershed area) was also considered. Recharge calculated by the watershed model becomes input to the groundwater model by simulating recharge along the active groundwater model cells at the base of the mountains. Annual recharge from mountain front runoff is shown on Figure 3-28.

3.3.5.2.2 Areal Recharge from Precipitation

Areal recharge from precipitation was also estimated by the surface water model based on precipitation, potential ET, soil type/coverage, land use, topography/slope, and other hydrologic properties.

Precipitation data were obtained from multiple precipitation stations within or outside the model boundary, including Henshaw Dam Station, Palomar Mountain Observatory Station, and Vista Station. Each station has varying periods and frequencies of recorded precipitation data. In addition, gridded estimates of monthly and annual precipitation were obtained in the form of PRISM maps. PRISM (Parameter-elevation Regression on Independent Slopes Model) was developed by the National Resources Conservation Service (NRCS) National Water and Climate Center (NWCC) and the PRISM Climate Group at Oregon State University. Gridded data represents the long-term (30-year) annual precipitation from 1981 through 2010.

Precipitation throughout the USLR Valley Groundwater Subbasin was then established based on observed rainfall at the nearby precipitation gaging stations, isohyetal contours of gridded historical average annual precipitation, and the establishment of precipitation adjustment factors to distribute/scale observed daily precipitation across the modeled area appropriately. Recharge from areal precipitation calculated by the watershed model becomes input to the groundwater model by simulating recharge to the uppermost model layer across the active groundwater area. Annual recharge from areal precipitation is shown on Figure 3-29.

3.3.5.2.3 Streambed Percolation

Historical daily streamflow data were obtained from two USGS gages (downloaded from the National Water Information System webpage) for varying periods of record (see Appendix 3d). The daily readings from these two gages (Station 11036700 San Luis Rey River Near Pauma Valley, and Station 11039800 San Luis Rey River Near Pala) were used to help calibrate the USLR Watershed Model. Henshaw Dam release data (minus diversions into the Escondido Canal) were also used as surface inflow for the watershed model, and surface diversion data from several surface water diversion locations were used in the watershed model to estimate streamflow. The model also takes into account runoff generated from precipitation events and the excess application of water at the surface, and tributary inflow.

Model output from the watershed model was then used as input for the groundwater model. Streambed percolation was estimated by the groundwater model using the Streamflow Routing Package. The Streamflow Routing Package routes tributary inflows through modeled stream networks and simulates streambed percolation based on streamflow, streambed conductance (refined during model calibration), and model-simulated groundwater levels. Annual recharge from streambed percolation is shown on Figure 3-30.

3.3.5.2.4 Return Flow from Applied Water

Return flow from applied water was estimated using return flow percentages from a recent study within the Temecula-Murrieta Groundwater Basin (Stetson, 2016), as summarized below.

Table 3-4. Return Flow Percentages

Water Use Type	Return Flow (% of Water Use)
Commercial/Industrial/Public Facilities	13%
Residential (High Density)	9%
Residential (Low Density)	11%
Agriculture/Parks/Golf Course	18%

Return flows are categorized by application (e.g., agricultural, municipal, or residential) and calculated based on estimated water use (including pumped groundwater and imported water). For residential return flows, indoor/outdoor water use percentages and septic return flows were refined based on values provided in Appendix D of the Stetson report (2016).

Return flows include water returned to the aquifer from imported water use in the basin. As mentioned previously, imported water use has increased through time. Annual imported water amounts are shown on Figure 3-31. Return flow from total water use (pumped, imported, or surface water supply) was then simulated in the groundwater model by applying estimated recharge volumes to the uppermost model layer. Annual recharge from return flow is shown on Figure 3-32.

3.3.5.2.5 Recycled Water Spreading

As described in Section 3.3.3.1.5, recycled water spreading occurs at the Pala wastewater treatment plant in Pala Subbasin and at the Pauma Valley Treatment Plant and Pauma Casino in Pauma Subbasin. Historical spreading records were available for operations at Pauma Valley Treatment Plant and were used for spreading activities at this site. Recharge from recycled water spreading at the two other facilities was assumed based on estimated pumping (or water usage), a 40% indoor water use percentage, 60% sewage connection (for Pala area), and 5% treatment loss. Annual estimated recharge from recycled water spreading is shown on Figure 3-33.

3.3.5.3 Groundwater Outflows

The general modeling approaches taken to estimate each groundwater outflow term through time based on measured data and/or the development of scientific assumptions are summarized below.

3.3.5.3.1 Groundwater Pumping

Groundwater pumping was based on historical pumping records, where available. Estimates of unrecorded pumping for those areas not served by a water service entity were primarily based on land use and published associated water use (including the demand estimates provided in Table 3-6 of the County's General Plan Update Groundwater Study; County, 2010) and other estimates of water use from previous studies. Since agricultural irrigation represents such a large portion of groundwater pumping in the basin, estimates of agricultural water use were based on crop type using available crop mapping data. Multi-year coverage was available from DWR at https://data.cnra.ca.gov/dataset/statewide-crop-mapping, as well as from SANDAG. Crop-specific agricultural demand estimates from the County's Table 3-6 were then applied to the areas identified by the crop mapping. Pumping estimations were also made for tribal areas, including casino usage, based on available reports (Geo-Logic Associates, 2009; Pala Band of Mission Indians, 2019; Stetson, 1984; Tierra Environmental Services, 2007). Estimated pumping rates were simulated in the groundwater model using the Well Package and assigned to the locations of known or estimated pumping. Annual estimated groundwater pumping is shown on Figure 3-34.

3.3.5.3.2 Underflow Outflow

Underflow outflow to downgradient Bonsall Subbasin was calculated by the groundwater model based on calibrated aquifer parameters, observed downstream groundwater elevations, and model-simulated groundwater elevations. Annual estimated underflow outflow is shown on Figure 3-35. As shown, underflow outflow to Bonsall has been fairly constant. Underflow outflow under projected (future) conditions is also not anticipated to change considerably (see Section 3.3.5.7).

3.3.5.3.3 Evapotranspiration

Evapotranspiration represents another value that is calculated by the groundwater model. The model uses the ET Package based on model-simulated groundwater elevations, and extinction depths and consumptive use estimates from previous studies (e.g., Muckel and Blaney, 1945; Moreland, 1974). Annual estimated underflow outflow is shown on Figure 3-36. ET volumes calculated by the model for the groundwater budgets represent the groundwater that is consumed by riparian vegetation and vegetation in areas of shallow groundwater. Interception of precipitation by other native vegetation relying on soil moisture from the unsaturated, or vadose, zone rather than groundwater is accounted for in the surface water model. Therefore, the water consumed by native vegetation

3.3.5.4 Change in Groundwater Storage

Change in groundwater storage is calculated as the sum of the inflow terms minus the sum of the outflow terms. Average annual change in groundwater storage for historical, current, and projected water budgets are presented in the following sections. The cumulative change in groundwater storage over the calibration period (1991 through 2020) is provided as Figure 3-37. The cumulative departure from mean annual precipitation at the Lake Henshaw Station is also shown on the figure. As shown on the figure, the change in groundwater storage largely responds to changes in hydrologic conditions (i.e., wet and dry periods cause rises and declines in groundwater storage, respectively).

3.3.5.5 Historical Water Budget

The historical water budget for the USLR Valley Groundwater Subbasin was evaluated over the model calibration period from January 1991 through December 2020. This 30-year period represents average hydrologic conditions (with an average precipitation of 24.8 inches per year compared to a long-term average of 24.3 inches per year from 1943 through 2020) and includes both dry and wet hydrologic periods. In addition, it represents the period of time for which information – such as water level and pumping data – becomes more readily available. Average annual inflow and outflow for the USLR Valley Groundwater Subbasin from the historical period (1991 through 2020) are summarized in the following table and on Figure 3-38. Annual terms are provided in attached Table 3-14.

Table 3-5. Upper San Luis Rey Valley Groundwater Basin – Historical Groundwater Budget (1991-2020)

	Term	Annual Average [acre-ft/yr]
Inflow	Recharge from Mountain Front Runoff	7,051
	Areal Recharge from Precipitation	3,790
	Streambed Percolation	6,007
	Return Flow from Applied Water	2,689
	Recycled Water Spreading	228
	Total Inflow	**19,765**
Outflow	Groundwater Pumping	14,263
	Subsurface Outflow	4,780
	Evapotranspiration (ET)	2,269
	Total Outflow	**21,313**
	Change in Groundwater Storage	**-1,548**

As shown in the table above, annual change in groundwater storage during the period from 1991 through 2020 was estimated to be -1,548 acre-ft/yr. This storage decline is reflected in observed water levels in the basin, especially Pauma Subbasin, which show general groundwater declines from the 1990s until the last 10 years or so.

3.3.5.6 Current Water Budget

Individual water budget terms for the evaluation of the current water budget for the USLR Valley Groundwater Subbasin were determined using the same approaches described above for the historical water budget, but over the last five years (i.e., 2016 through 2020). Hydrology (i.e., precipitation) during this period is slightly higher than the long-term average precipitation observed at Henshaw Dam: 25.7 inches versus 24.3 inches. This above average rainfall contributes additional groundwater recharge through mountain front runoff, areal recharge from precipitation, and streambed percolation. In addition, groundwater pumping and return flows are typically reduced since additional irrigation demand would be met with natural recharge rather than having to rely on pumped groundwater or imported water supplies.

Average annual inflow and outflow for the USLR Valley Groundwater Subbasin from the current period (2016 through 2020) are summarized in the following table and on Figure 3-39. Annual terms are provided in attached Table 3-14.

Table 3-6. Upper San Luis Rey Valley Groundwater Basin – Current Groundwater Budget (2016-2020)

	Term	Annual Average [acre-ft/yr]
Inflow	Recharge from Mountain Front Runoff	9,262
	Areal Recharge from Precipitation	4,942
	Streambed Percolation	10,662
	Return Flow from Applied Water	2,320
	Recycled Water Spreading	295
	Total Inflow	**27,481**
Outflow	Groundwater Pumping	12,235
	Subsurface Outflow	5,008
	Evapotranspiration (ET)	2,126
	Total Outflow	**19,369**
	Change in Groundwater Storage	**8,111**

The water budget presented above supports the water levels observed throughout much of the basin – indicating recovery in water levels and groundwater storage over the last five to ten years or so. A combination of above average precipitation and increased use of imported water has allowed groundwater storage to recover by over 8,000 acre-ft/yr for the last five years.

3.3.5.7 Projected Water Budget

The historical and current water budgets presented above are based on land use conditions and annual groundwater pumping under the historical conditions for the period in question (1991 through 2020 for historical and 2016 through 2020 for current). The projected water budget needs to account for water demands based on long-term water supply planning by basin stakeholders. As discussed in the Plan Area section (Section 2.3), land use in the USLR Valley Groundwater Subbasin is not anticipated to change much. Land and water use will remain predominantly agricultural and projected residential increases are expected to have negligible effect on overall water demand. Therefore, the projected water budget was evaluated using the average pumping and associated return flows from the past five years (2016 through 2020) and average hydrologic conditions using historical precipitation from 1991 through 2020, repeated twice to provide a 60-year projection.

Projected average annual inflow and outflow for the USLR Valley Groundwater Subbasin (using repeating hydrologic conditions from 1991 through 2020) are summarized in the following table and on Figure 3-40. Annual terms are provided in attached Table 3-15.

Table 3-7. Upper San Luis Rey Valley Groundwater Basin – Projected Groundwater Budget (2022-2081)

	Term	Annual Average [acre-ft/yr]
Inflow	Recharge from Mountain Front Runoff	7,051
	Areal Recharge from Precipitation	3,790
	Streambed Percolation	6,914
	Return Flow from Applied Water	2,483
	Recycled Water Spreading	295
	Total Inflow	**20,532**
Outflow	Groundwater Pumping	13,659
	Subsurface Outflow	4,858
	Evapotranspiration (ET)	2,123
	Total Outflow	**20,641**
	Change in Groundwater Storage	**-109**

A continuation of current water use practices in the basin for the next 60 years, assuming average hydrologic conditions, is anticipated to cause additional groundwater storage declines of approximately 100 acre-ft/yr. This indicates that current pumping conditions are approximately equal to the sustainable yield of the basin. Additional groundwater management actions, such as water conservation or imported water use (see Section 4.0) may be able to mitigate the slight projected depletion of groundwater storage.

However, as mentioned previously, the projected water budget presented above assumes the continuation of current basin conditions, including pumping volumes, water use, application rates, return flows, etc. If water use (especially pumping volumes) increases in the basin, then additional projects and/or management actions will be needed to help address decreases in groundwater elevations, depletions in groundwater storage, and potential effects on interconnected surface water flow.

3.3.5.8 Estimate of Sustainable Yield

Sustainable yield is defined by SGMA (Water Code, section 10721(w)) as the maximum quantity of water, calculated over a base period representative of long-term conditions in the basin and including any temporary surplus, that can be withdrawn annually from a groundwater supply without causing an undesirable result. In the USLR Valley Groundwater Subbasin, the chronic lowering of groundwater levels and significant and/or unreasonable reduction of groundwater storage would represent the primary undesirable results. Other undesirable results include significant and unreasonable degraded groundwater quality and depletions of interconnected surface water that have significant and unreasonable adverse impacts on beneficial uses of the surface water. Given local conditions in the subbasin, and as discussed previously, seawater intrusion and land subsidence are not anticipated to contribute to potential undesirable results in the subbasin.

Previous estimates of sustainable, or safe, yield are summarized below.

Table 3-8. Previous Estimates of Sustainable Yield for the Upper San Luis Rey Valley Groundwater Subbasin

Source	Pauma Subbasin	Pala Subbasin	Total Upper San Luis Rey Valley
		[acre-ft/yr]	
Ellis and Lee (1919)	-	-	7,640
Moreland (1974)	4,530	2,545	7,075

Given local conditions and the potential undesirable results discussed above, sustainable yield for the USLR Valley Groundwater Subbasin was considered to be the amount of groundwater pumping achievable with no change in groundwater storage. Through evaluation of the subbasin water budgets, an increase in groundwater storage indicates that additional sustainable yield is available (e.g., pumping is well within sustainable rates). If, however, the pumping results in a negative change in storage, groundwater pumping is in excess of the sustainable yield. The determination of sustainable yield can therefore be expressed as:

Sustainable Yield = Pumping +/- Change in Storage

Groundwater pumping in the subbasin was estimated based on water demand (see description of groundwater pumping estimates in Section 3.3.5.3.1, above), reported pumping (obtained from basin stakeholders), and records of supplemental imported water use (which offsets the need for additional groundwater pumping). Total average groundwater pumping for the period from 1991 through 2020 was estimated to be approximately 14,300 acre-ft/yr. The change in groundwater storage from 1991 to 2020 is approximately -1,500 acre-ft/yr. This general decrease in groundwater storage is supported by groundwater level declines observed in the subbasin, particularly for the period from the 1990s through the early 2000s (see Section 3.3.4.1).

Preliminary estimates of sustainable yield for the current investigation are provided below. These values should continue to be refined as additional information is collected following GSP implementation.

Table 3-9. Estimates of Sustainable Yield for the Upper San Luis Rey Valley Groundwater Subbasin

Period	Groundwater Pumping	Change in Storage	Sustainable Yield
		[acre-ft/yr]	
Historical Period (1991 – 2020)	14,300	-1,500	12,700
Current Period (2016 – 2020)	12,200	8,100	20,300
Projected Period (2022 – 2081)	13,700	-100	13,600

As shown above, historical sustainable yield in the USLR Valley Groundwater Subbasin is estimated to be approximately 12,700 acre-ft/yr. This is larger than previous estimates of sustainable yield by Ellis and Lee (1919) and Moreland (1974), which were on the order of 7,000 to 8,000 acre-ft/yr, but much of the difference may be explained by difference in estimation approach. The sustainable yield estimate developed by Ellis and Lee looked at the volume of groundwater that could be extracted over a 3-year period assuming no or negligible recharge (i.e., extreme drought period), be adequately replenished the following year, and be completely replenished prior to the next drought. This methodology is somewhat unclear, but the area used for the analysis of the "San Luis Rey Valley (Upper)" appears to only encompass approximately 4,400 acres. The active model area developed for this GSP investigation area is just over 13,000 acres. The Moreland (1974) investigation provides a water budget table for both Pauma and Pala Subbasins. Sustainable yield was then estimated following the equation presented above, whereby the yield may be expressed as the pumping plus or minus the change in groundwater storage. However, the change in storage presented by Moreland was not calculated or verified independently of his pumping/water budget term estimations as was done for the preliminary GSP estimate. That is, the change in storage presented by Moreland was calculated as the sum of the estimated inflows minus the sum of the outflows and did not consider observed change(s) in groundwater elevations. The change in storage (and, in turn, sustainable yield estimate) is therefore directly related to the assumptions he made for each individual groundwater budget term and the various uncertainties associated with them.

The historical sustainable yield value provided here represents an estimate of pumping that will result in no long-term depletion of groundwater storage for representative, long-term average hydrologic conditions. However, sustainable yield is not a constant value. Due to changes in annual precipitation – and therefore natural recharge – sustainable yield can be assumed to fluctuate annually. This will result in a fluctuation of groundwater storage corresponding to wet and dry hydrologic cycles, but it is assumed that the sustainable yield pumping will result in generally stable groundwater storage that will not trend towards depletion over the long-term. In addition, sustainable yield varies depending on cultural conditions in the subbasin, such as changes in land use within the subbasin and irrigation practices, water supply sources (native vs. supplemental), and water management programs (increased use of recycled water or surface water, etc.). This is apparent in estimates of sustainable yield using current groundwater budgets. Under the conditions experienced over the last five years, sustainable yield is estimated to be closer to 20,300 acre-ft/yr.

Future changes in these conditions should be considered through periodic future updates of sustainable yield estimates. An opportunity to refine sustainable yield estimates for the USLR Valley Groundwater Subbasin is provided through future SGMA-required reporting. These reports will incorporate additional metered flows, providing a better indication of actual groundwater pumping, and supplemental water levels established by the proposed monitoring network (Section 5.0).

In addition, since the change in groundwater storage also relates to the amount of groundwater inflows and outflows experienced in the basin, sustainable yield may be increased through supplemental recharge, such as the use of imported water from outside the subbasin to supplement water supply. This additional water, which was not extracted from groundwater reserves within the subbasin, provides return flows (i.e., groundwater recharge) that have been shown to be beneficial in maintaining and even leading to the recovery of groundwater levels. Previous estimates of sustainable yield summarized in the table above represent older estimates with lower or no imported water contributions. The increased use of imported water through time, especially in recent years, contributes to an increased estimated sustainable yield for the USLR Valley Groundwater Subbasin over previous estimates as well as a higher sustainable yield under current water use conditions. If current water use and land use continues into the future, sustainable yield is estimated to be approximately 13,600 acre-ft/yr. However, maintaining this level of sustainable yield requires the continued use of supplemental imported water supplies in the subbasin. Reduction of return flows from imported water without a similar reduction in groundwater pumping will eventually cause groundwater levels, and therefore groundwater storage, in the subbasin to fall. Additional discussion of factors that could influence future sustainable yield is provided in the following sections.

3.3.5.8.1 Impact of Climate Change

An estimate of predicted climate change is provided through the SGMA Climate Change Technical Advisory Group (CCTAG) guidance document (DWR, 2018). The CCTAG reviewed an ensemble of climate simulations to develop change factors for precipitation and evapotranspiration. The climate change factors were downscaled to the Variable Infiltration Capacity (VIC) land surface model grid by the CCTAG. Each VIC grid cell contains a change factor which varies by month and location.

Using VIC cells encompassing the USLR Valley Groundwater Subbasin, the average precipitation climate change factor shows a reduction in precipitation under 2030 climate change conditions of approximately 1 percent. Under 2070 conditions, precipitation is projected to be reduced by 3 percent. Generally, increases in precipitation are anticipated in summer months. However, these months have little precipitation, so these increases do not correspond to large increases in rainfall amount. Decreases during October through December account for the primary reduction in overall precipitation. ET is anticipated to increase approximately 4 percent per 2030 climate change guidance and 10 percent per 2070 climate change guidance. The ET change factors show greater uniformity than precipitation factors, which are more variable.

An estimation of climate change impacts on the projected sustainable yield of the USLR Subbasin was made by adjusting model-estimated groundwater recharge and discharge terms influenced by natural processes (i.e., areal recharge from precipitation, recharge from mountain front runoff, streambed percolation, and ET) based on the anticipated changes to precipitation and ET discussed above. While actual reduction in precipitation and increases in ET will not have a directly linear impact on groundwater recharge and discharge, this evaluation presents an initial estimate of effects from these changes. A summary of the potential effects of climate change on projected sustainable yield in the subbasin is provided below.

Table 3-10. Projected Sustainable Yield and Impact of Potential Climate Change

Hydrologic Condition	Groundwater Inflow	Groundwater Outflow	Change in Storage	Sustainable Yield
		[acre-ft/yr]		
Historical Hydrology	20,500	20,600	-100	13,600
2030 Climate Change	20,400	20,700	-300	13,400
2070 Climate Change	20,000	20,900	-900	12,800

As shown in the table above, sustainable yield is anticipated to be reduced by approximately 200 acre-ft/yr under 2030 climate change conditions and 800 acre-ft/yr under 2070 conditions. Therefore, if future conditions follow predicted climate change modeling, implementing management actions and projects for sustainability (as discussed in Section 6.0) may become increasingly important in the future. This includes augmenting basin groundwater supply with additional sources of water. Proposed projects and management actions to diversify water supply, efficiently use existing sources of water, and increase available recharge are discussed in Section 6.0.

While running a model scenario with the adjusted natural recharge and discharge terms would result in a more comprehensive analysis of potential impacts from climate change (by calculating the change in additional groundwater budget terms such as underflow outflow), there is significant uncertainty associated with future and model conditions. These include but are not limited to: DWR modeled climate change assumptions, future land use and water use in the subbasin, and groundwater conditions and parameters from the USLRGM which was calibrated using a limited dataset (spatially and temporally). Incorporating additional information on pumping, groundwater level conditions, and surface flow in the USLR Groundwater Subbasin as it becomes available through future data collection efforts will allow estimates of sustainable yield to be refined. In addition, this increased understanding will improve model reliability. Additional modeling scenarios may be run as needed to evaluate future or projected conditions, including assessing impacts from climate change and proposed management actions or projects.

3.3.5.8.2 Imported Water Reliability

As discussed in Section 2.1.2.3, YMWD receives imported water from the Water Authority. The Water Authority states that its *"supply portfolio includes high-priority, independent Colorado River supplies negotiated through the landmark 2003 Quantification Settlement Agreement, or QSA. These highly reliable supplies are the cornerstone of the San Diego region's long-term water supply diversification* *strategy. In addition, the Water Authority purchases Colorado River water from the Metropolitan Water District of Southern California"* (Metropolitan) (Water Authority website[18]). The Water Authority receives approximately 280,000 acre-feet annually from these efforts, comprising around half of the San Diego region's total water supply.

Water Authority receives State Water Project (SWP) water through Metropolitan but is progressively reducing reliance on SWP water. The availability of SWP water in any given year is based on hydrologic trends in the preceding years. For long-term reliability, DWR as provided estimates of the availability of Table A deliveries based on an 82-Year historical period for both wet and dry hydrologic cycles. Tables 3-11 and 3-12 below are reproduced from the August 26, 2020 "Final State Water Project Capability Report 2019".

Table 3-11. Estimated Average and Wet-Period Deliveries of State Water Project Table A Water (Existing Conditions, in TAF/year) and Percent of Maximum State Water Project Table A Amount, 4,133 TAF/year

Year	Long-Term Average	Single Wet Year (1983)	Wet Periods			
			2-Year (1982-1983)	4-Year (1980-1983)	6-Year (1978-1983)	10-Year (1978-1987)
2017 Report	2,571 (62%)	4,098 (99%)	3,967 (96%)	3,569 (86%)	3,433 (83%)	3,163 (77%)
2019 Report	2,414 (58%)	4,008 (97%)	3,750 (91%)	3,330 (81%)	3,210 (78%)	2,967 (72%)

Source: Table 5-5 in DWR, 2020b
TAF = thousand acre-ft

Table 3-12. Estimated Average and Dry-Period Deliveries of State Water Project Table A Water, Excluding Butte County and Yuba City (Existing Conditions, in TAF/year) and Percent of Maximum State Water Project Table A Amount, 4,133 TAF/year

Year	Long-Term Average	Single Wet Year (1977)	Dry Periods			
			2-Year (1976-1977)	4-Year (1931-1934)	6-Year (1987-1992)	10-Year (1929-1934)
2017 Report	2,571 (62%)	336 (8%)	1,206 (29%)	1,397 (34%)	1,203 (29%)	1,408 (34%)
2019 Report	2,414 (58%)	288 (7%)	1,311 (32%)	1,228 (30%)	1,058 (26%)	1,158 (28%)

Source: Table 5-6 in DWR, 2020b
TAF = thousand acre-ft

During the most recent drought from 2012 through 2016, delivery of Table A allocations ranged from 5 to 65 percent, with an average 5-year delivery of 37 percent (DWR, 2022a). In their Notice to State Water Project Contractors dated January 20, 2022, DWR recently increased the 2022 SWP Table A Allocation

18 https://www.sdcwa.org/your-water/imported-water-supplies/

from 0 to 15 percent. According to the notice, *"the Table A Allocation increase is made consistent with the long-term water supply contracts, legal requirements, and public policy. In determining available SWP supplies, DWR has considered several factors including existing storage in SWP conservation reservoirs, estimates of future runoff under very dry conditions, SWP operational and regulatory constraints such as, Endangered Species Act and California Endangered Species Act requirements, and the 2022 demands of SWP Contractors. DWR may revise this and any subsequent allocations if warranted by the year's developing hydrologic and water supply conditions."* YMWD will continue to work with the Water Authority provide imported water supplies as a part of the water portfolio for USLR subbasin.

3.3.5.9 Quantification of Overdraft

A groundwater basin is generally regarded as being in overdraft when pumping exceeds natural and artificial groundwater recharge. As presented above, the preliminary estimate of sustainable yield for the USLR Valley Groundwater Subbasin is approximately 12,700 acre-ft/yr. This value indicates that historical pumping rates of 14,300 acre-ft/yr were in excess of sustainable yield by approximately 1,500 acre-ft/yr. This additional pumping resulted in observed water level and groundwater storage declines. Current pumping, however, is estimated to be below the estimated historical sustainable yield of 12,700 acre-ft/yr. Lower pumping rates, in conjunction with average to wet hydrological conditions, has contributed to increases in groundwater levels seen in many parts of the basin within the last five to ten years. It is important to note that these pumping and sustainable yield numbers still need to be verified through additional data collection and model refinement. Additional pumping data can be used to verify pumping estimates and associated assumptions and allow for the refinement and recalibration of the groundwater model that will, in turn, improve confidence in sustainable yield estimates.

Pauma and Pala Subbasins were considered to be at or near hydrologic balance in the 1984 study by Stetson. Following this study, groundwater elevations – particularly in Pauma Subbasin – showed declines from the 1990s through the early 2000s. Over the last ten years or so, water levels have recently stabilized and have started to show recovery. This seems to be due in large part to the use of imported water to augment groundwater supplies, allowing for a reduction in groundwater pumping. Since land use in the subbasin is not anticipated to change very much in the future, water demand will also likely remain at or near current levels. Future unanticipated changes in water demand and/or imported water supplies could result in the basin falling out of sustainable management.

3.4 Management Areas (§354.20)

Management areas can be used in a groundwater basin to control and/or mitigate the development of undesirable effects. No separate management areas are anticipated to be required for the current management and operation of the USLR Valley Groundwater Subbasin.

3.5 References (§354.4(b))

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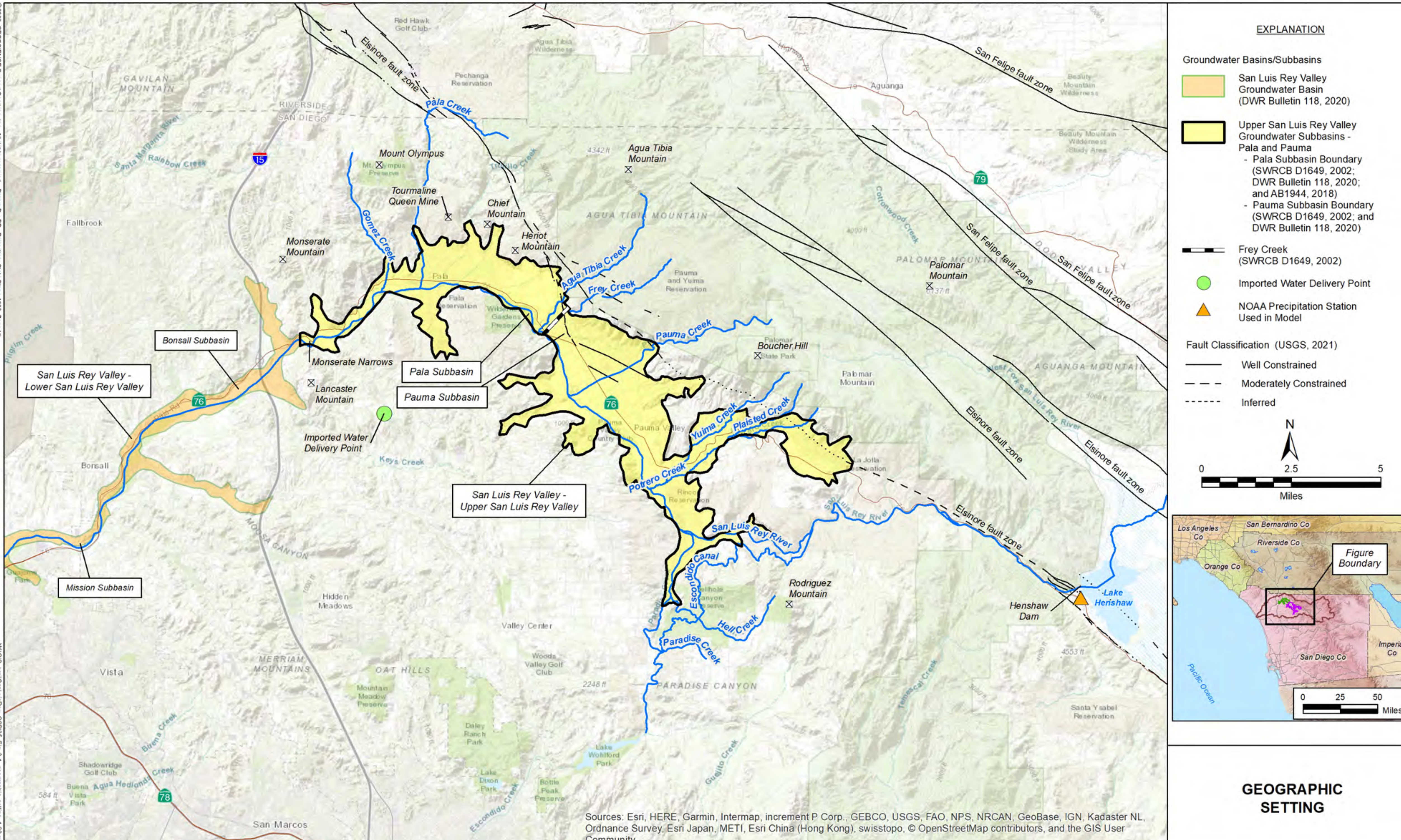

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Jan-22

GEOGRAPHIC SETTING

FIGURE 3-1

GEOSCIENCE

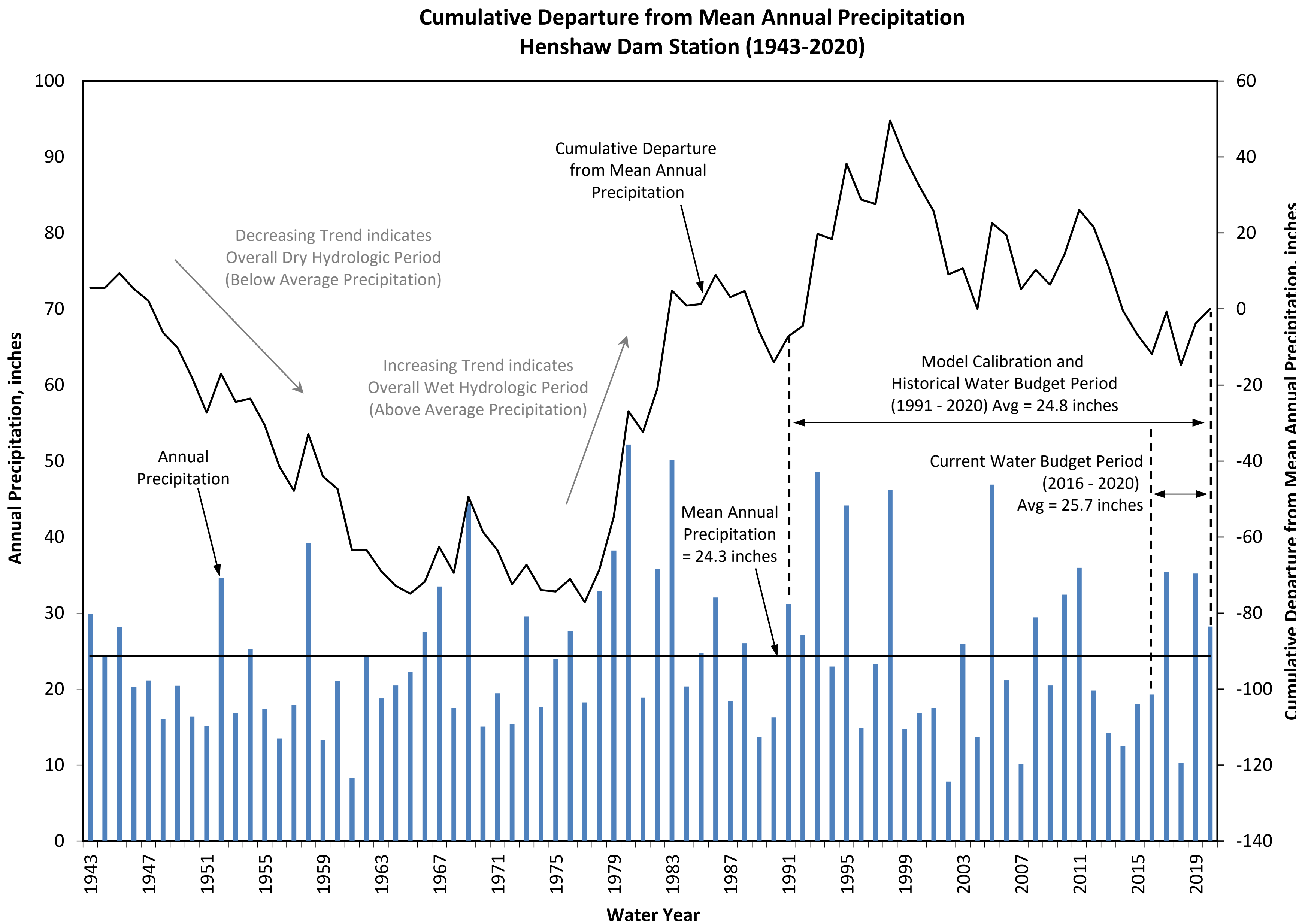
Cumulative Departure from Mean Annual Precipitation
Henshaw Dam Station (1943-2020)
Annual Precipitation, inches
Cumulative Departure from Mean Annual Precipitation, inches
Water Year
Decreasing Trend indicates Overall Dry Hydrologic Period (Below Average Precipitation)
Increasing Trend indicates Overall Wet Hydrologic Period (Above Average Precipitation)
Cumulative Departure from Mean Annual Precipitation
Annual Precipitation
Mean Annual Precipitation = 24.3 inches
Model Calibration and Historical Water Budget Period (1991 - 2020) Avg = 24.8 inches
Current Water Budget Period (2016 - 2020) Avg = 25.7 inches
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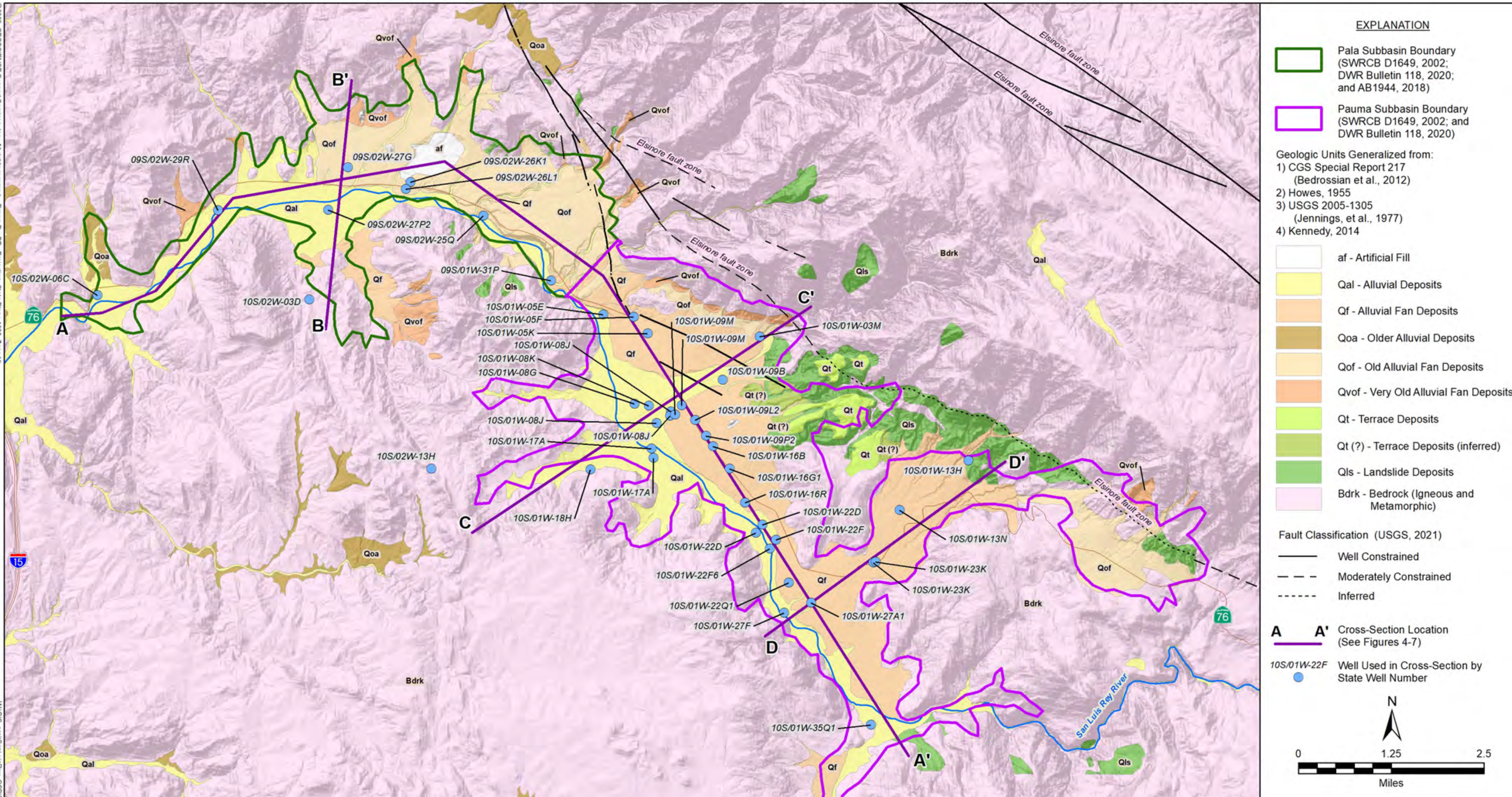
Figure 3-2



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SURFICIAL GEOLOGY

Jan-22

FIGURE 3-3

CROSS-SECTION A-A'

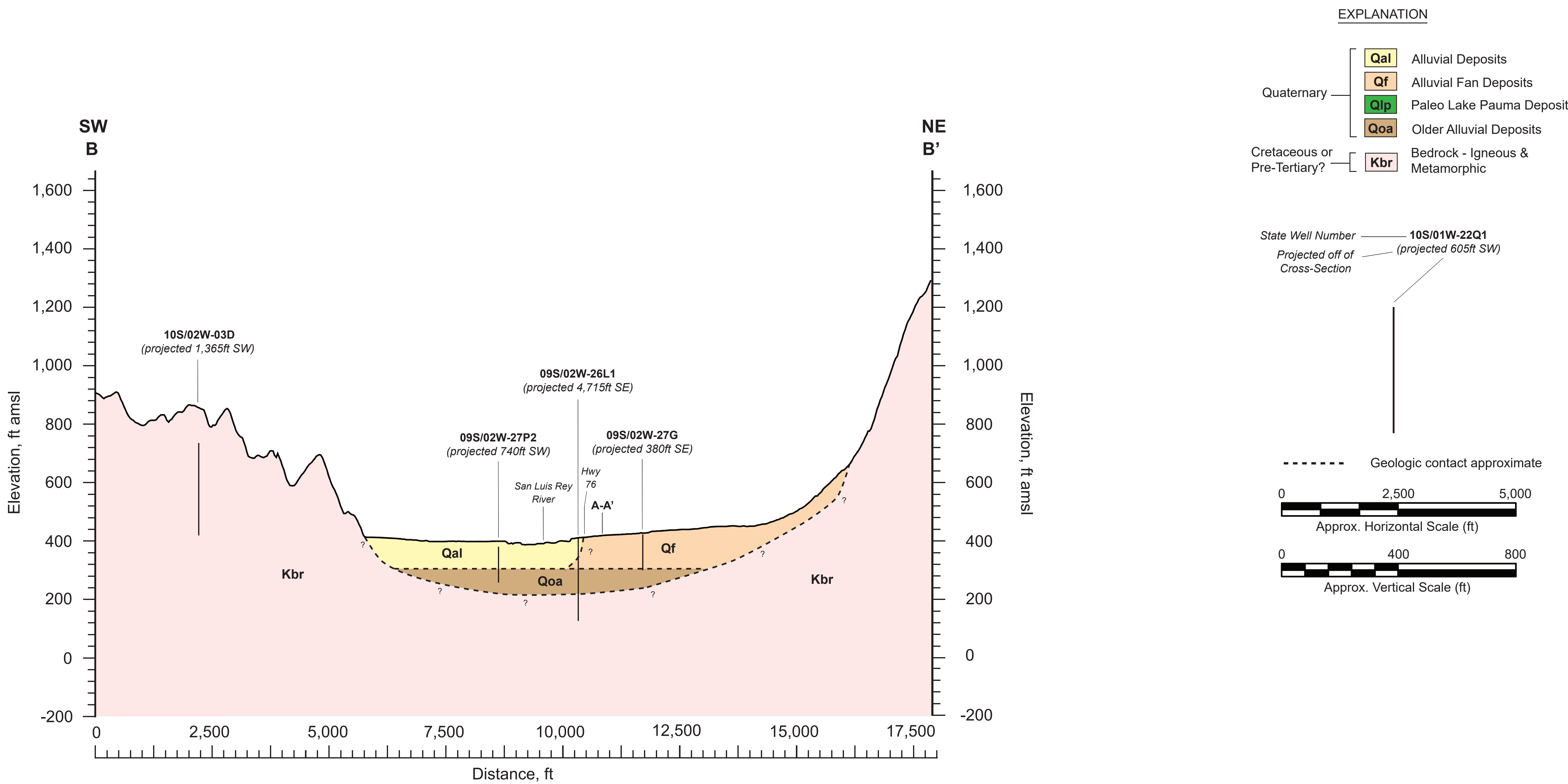
Jan-22

PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 3-4

GEOSCIENCE



CROSS-SECTION B-B'

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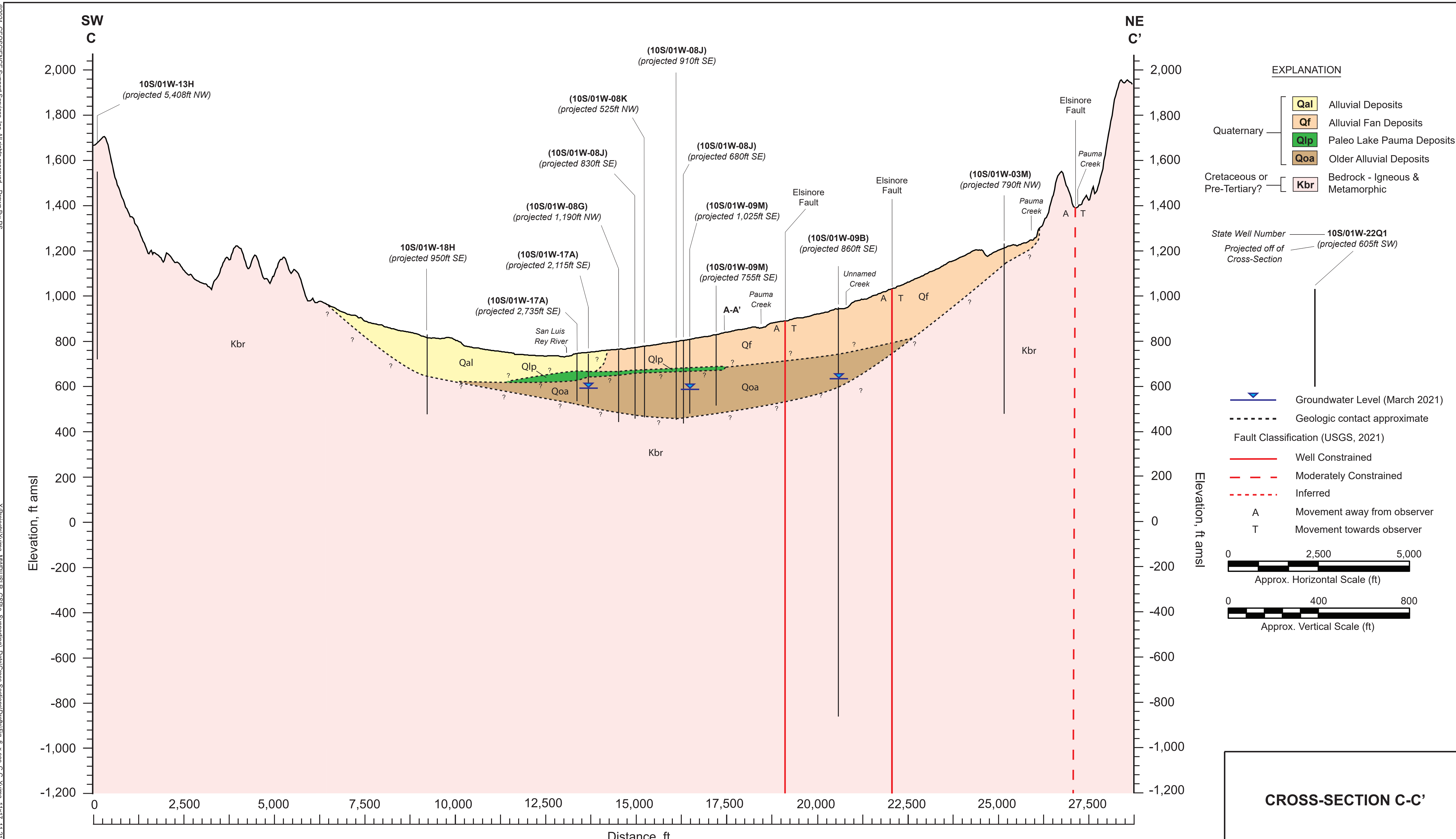
Jan-22



X:Projects\Yuma_MWD\USLR_GSP\e_Supporting_Data\Cross-Sections\Drafts\Fig_6_x-sec_C-C_Yuma_11x17_11-21.ai

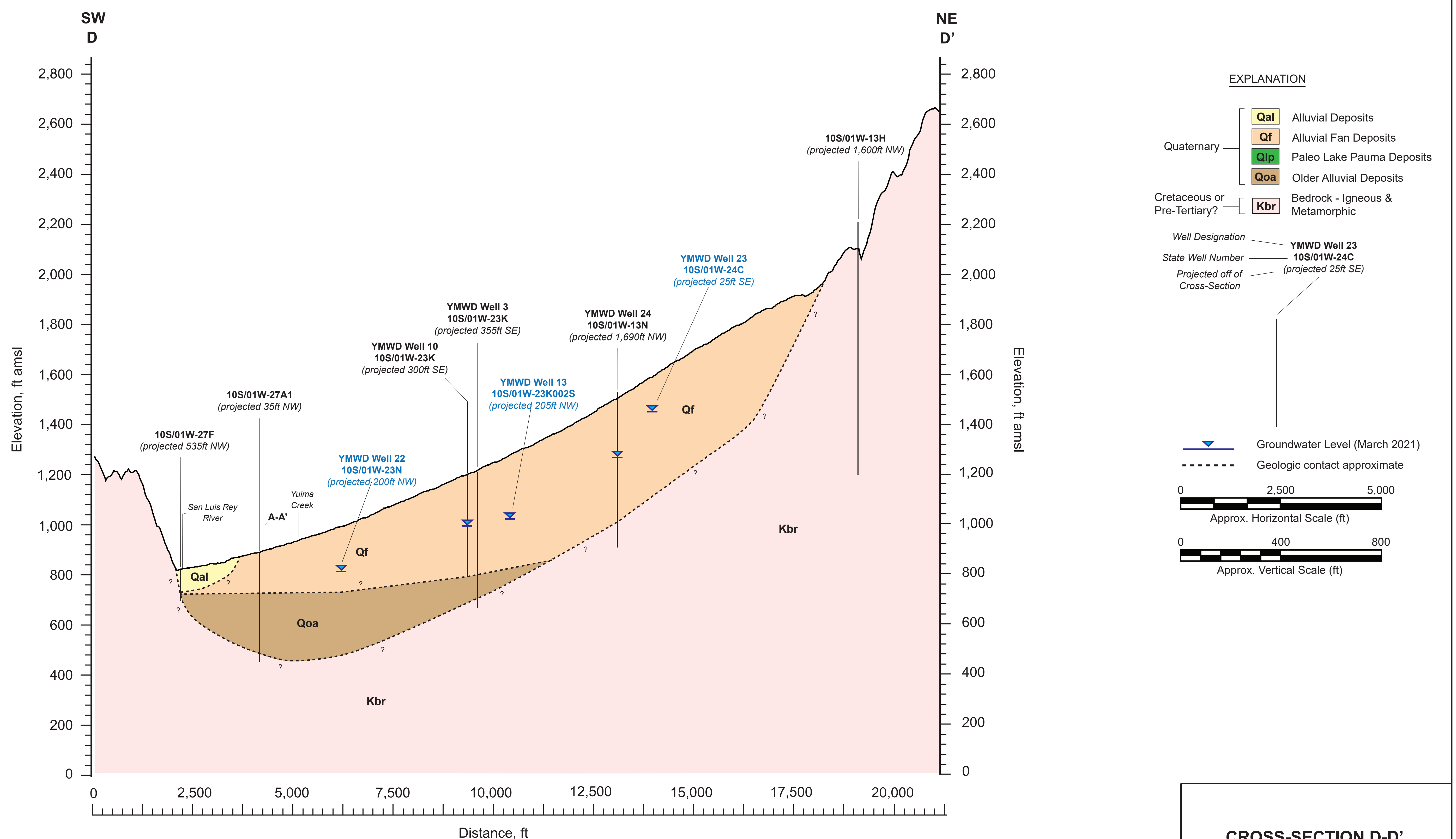
Jan-22

PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 3-6

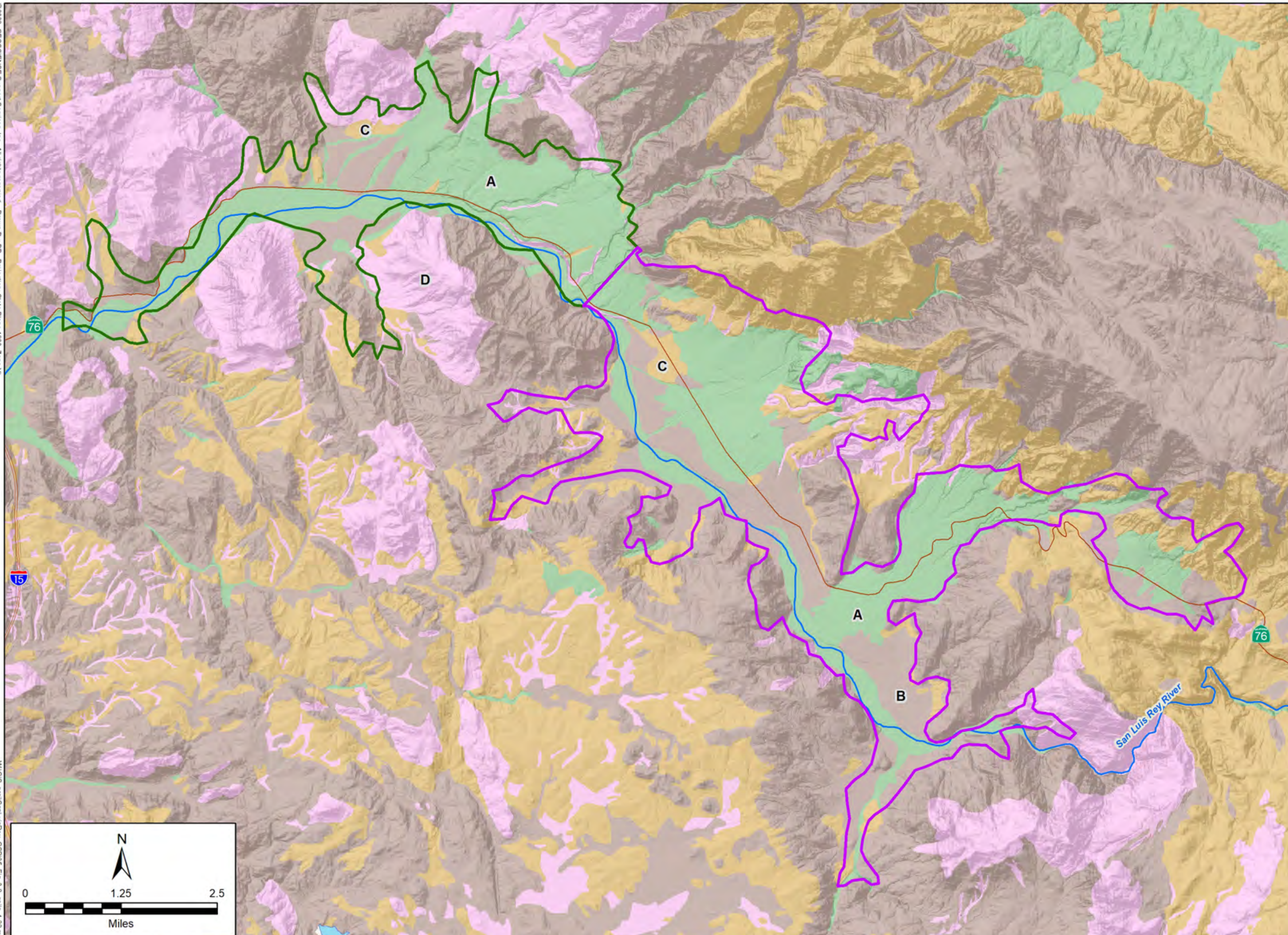
GEOSCIENCE



CROSS-SECTION D-D'

X:Projects\Yuima_MWD\USLR_GSPie_Supporting_Data\Cross-Sections\Drafts\Fig_7_x-sec_D-D_Yuima_11x17_11-21.ai

Jan-22



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Soil Survey Geographic (SSURGO) Soil Type (Soil Survey Staff et al., 2020)

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

SOIL HYDROLOGIC GROUPS

W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-8_soils_1-22.mxd

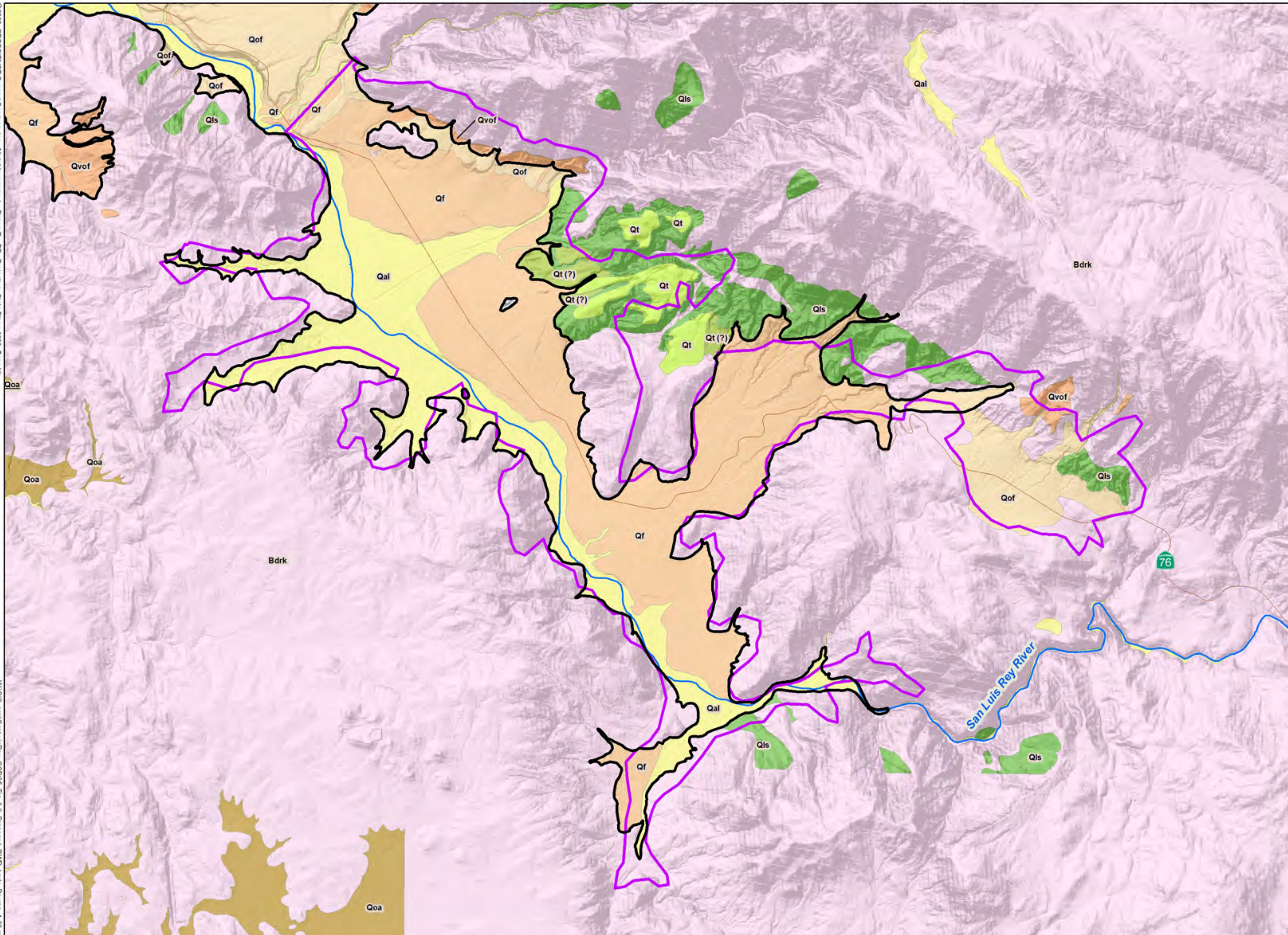
Jan-22

PAUMA VALLEY GSA

FIGURE 3-8

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



EXPLANATION

- Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)
- Proposed Pala/Pauma Subbasin Boundary (Refer to Section 3.3.1)

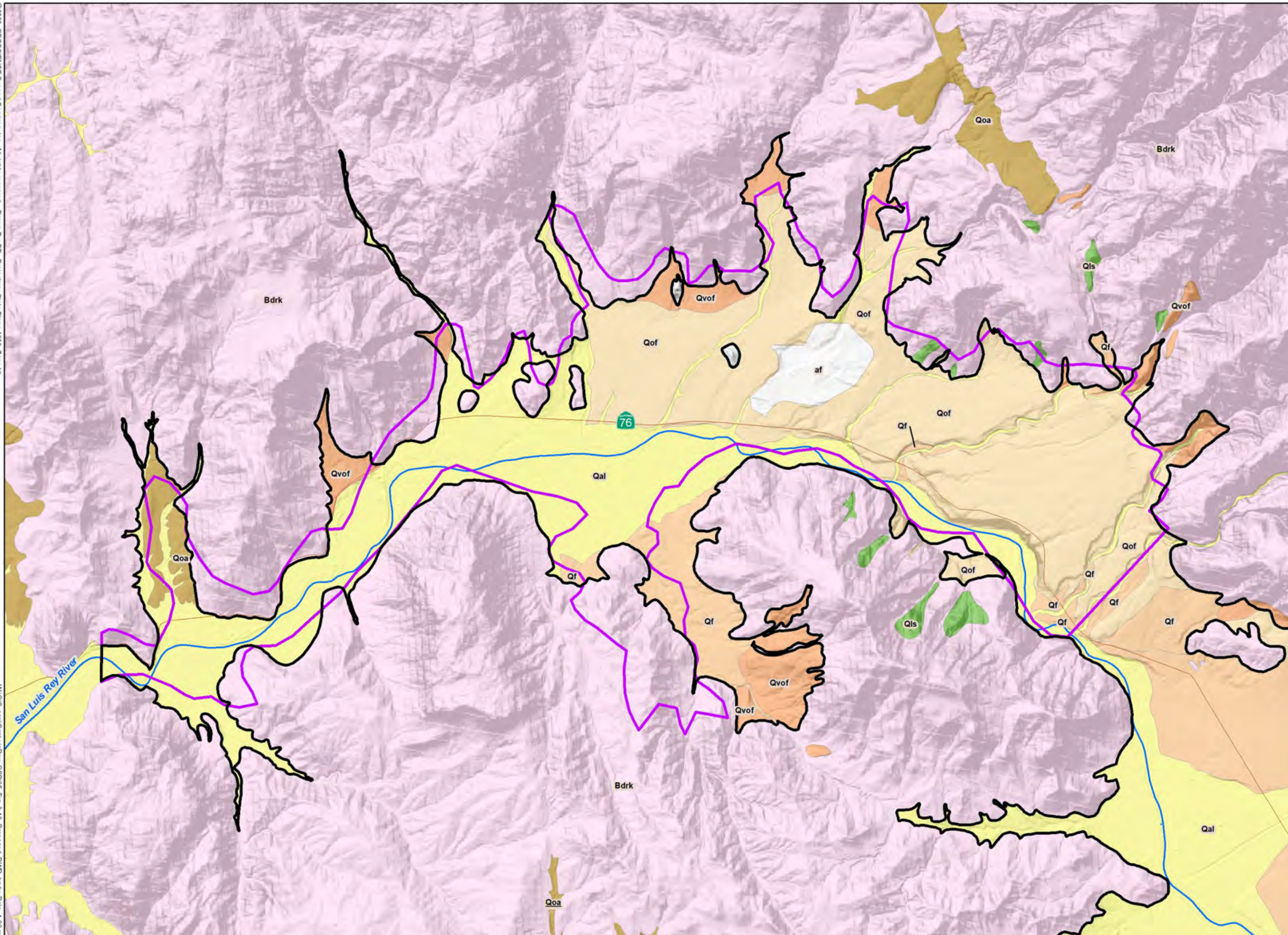
Geologic Units Generalized from:
1) CGS Special Report 217 (Bedrossian et al., 2012)
2) Howes, 1955
3) USGS 2005-1305 (Jennings, et al., 1977)
4) Kennedy, 2014

- Qal - Alluvial Deposits
- Qf - Alluvial Fan Deposits
- Qoa - Older Alluvial Deposits
- Qof - Old Alluvial Fan Deposits
- Qvof - Very Old Alluvial Fan Deposits
- Qt - Terrace Deposits
- Qt (?) - Terrace Deposits (inferred)
- Qls - Landslide Deposits
- Bdrk - Bedrock (Igneous and Metamorphic)

W:\GIS_proj\SanLuisRey_GSP\G5_Fig_3-9_Proposed_DWR_bndy_Pauma_1-22.mxd

PROPOSED GROUNDWATER BASIN BOUNDARIES FOR FUTURE UPDATE - PAUMA SUBBASIN

Jan-22



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Proposed Pala/Pauma Subbasin Boundary (Refer to Section 3.3.1)

Geologic Units Generalized from:
1) CGS Special Report 217 (Bedrossian et al., 2012)
2) Howes, 1955
3) USGS 2005-1305 (Jennings, et al., 1977)
4) Kennedy, 2014

af - Artificial Fill
Qal - Alluvial Deposits
Qf - Alluvial Fan Deposits
Qoa - Older Alluvial Deposits
Qof - Old Alluvial Fan Deposits
Qvof - Very Old Alluvial Fan Deposits
Qls - Landslide Deposits
Bdrk - Bedrock (Igneous and Metamorphic)

N

0 0.75 1.5
Miles

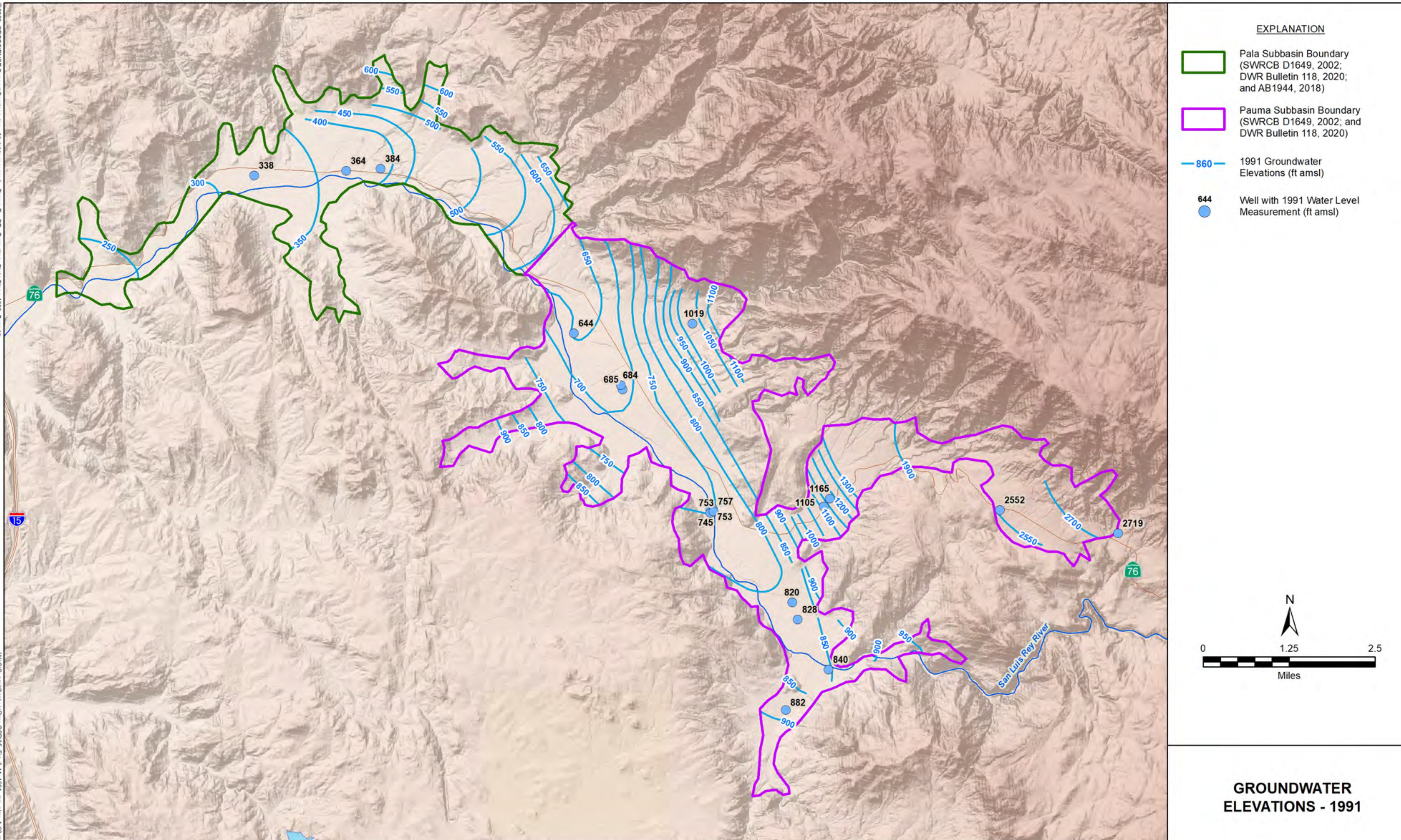
PROPOSED GROUNDWATER BASIN BOUNDARIES FOR FUTURE UPDATE - PALA SUBBASIN

W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-10_Proposed_DWR_bndy_Pala_1-22.mxd

Jan-22

FIGURE 3-10

GEOSCIENCE



W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-11_1991_gw_elev_1-22.mxd

Jan-22

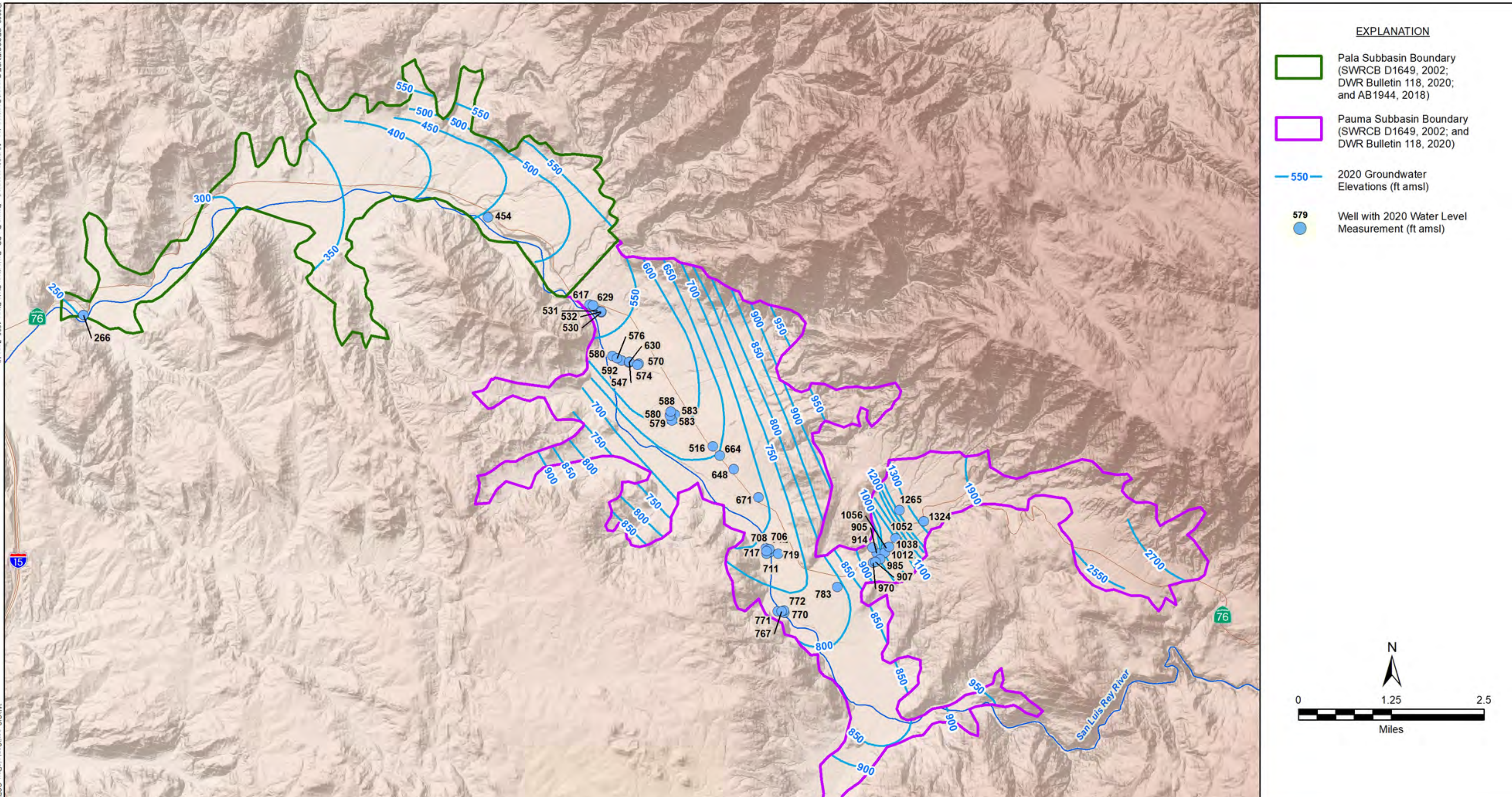
GROUNDWATER ELEVATIONS - 1991

PAUMA VALLEY GSA

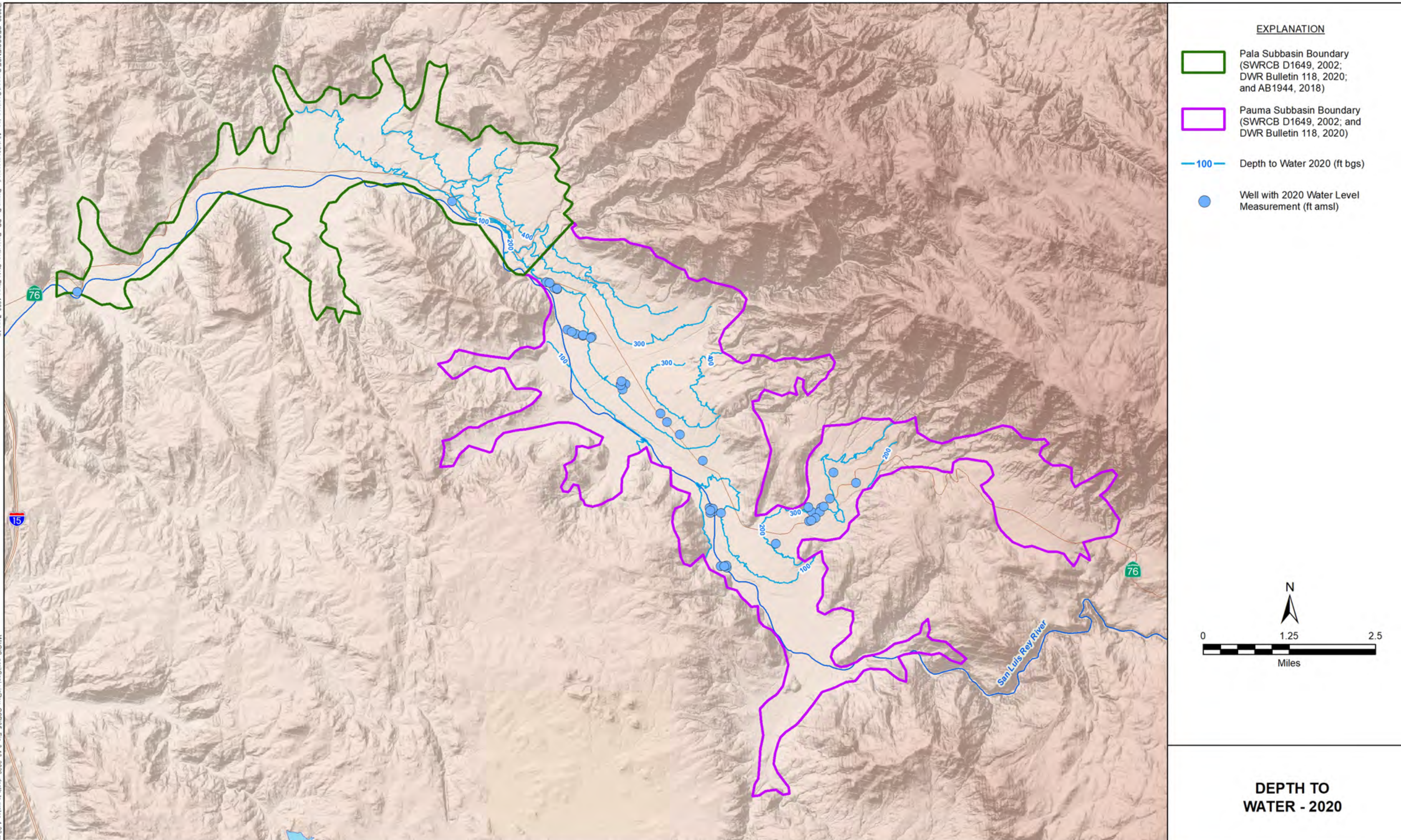
UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 3-11

GEOSCIENCE



GROUNDWATER ELEVATIONS - 2020



W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-13_2020_depth-to-water_1-22.mxd

DEPTH TO WATER - 2020

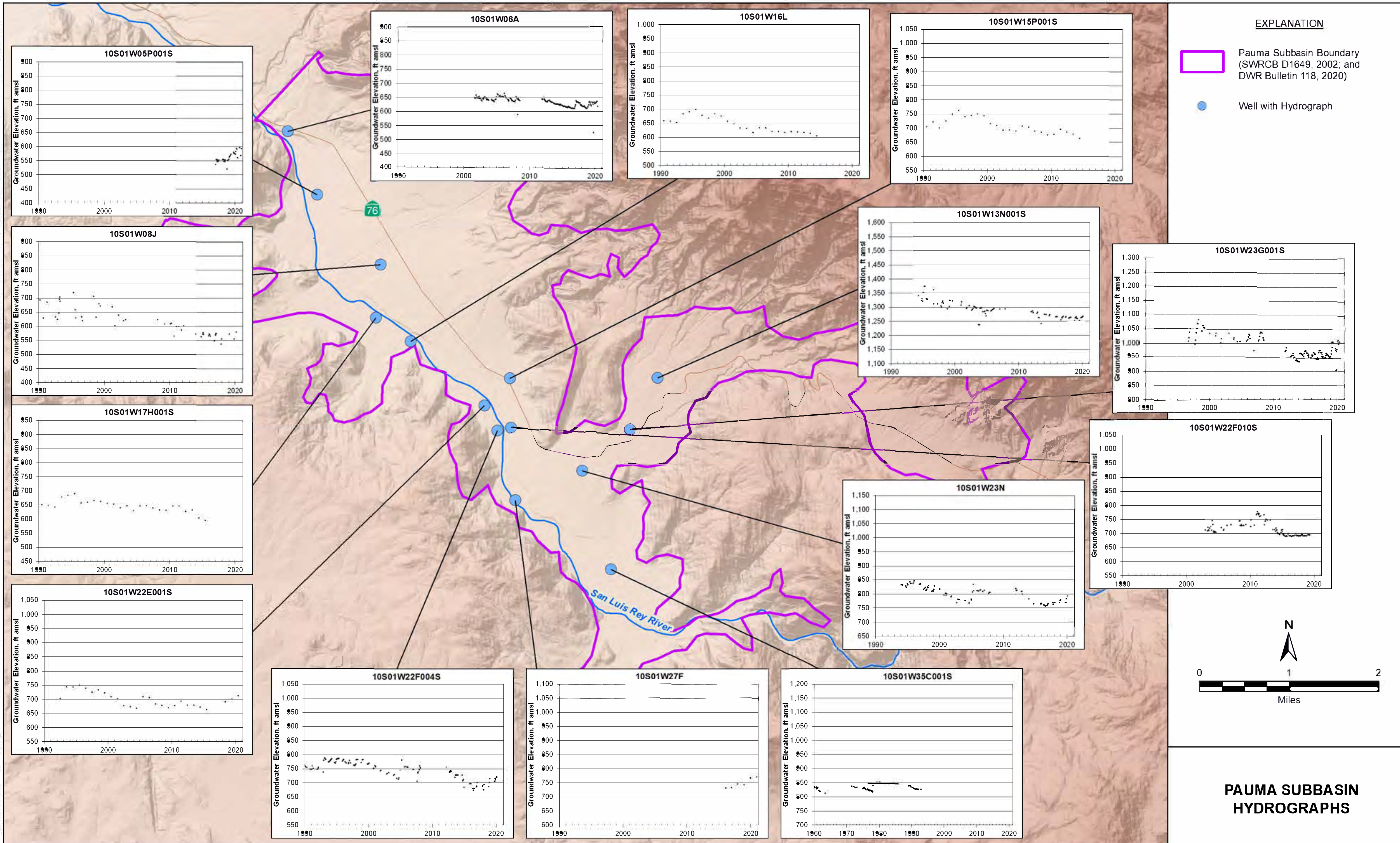
Jan-22

DRAFT

PAUMA VALLEY GSA **FIGURE 3-13**

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



PAUMA SUBBASIN HYDROGRAPHS

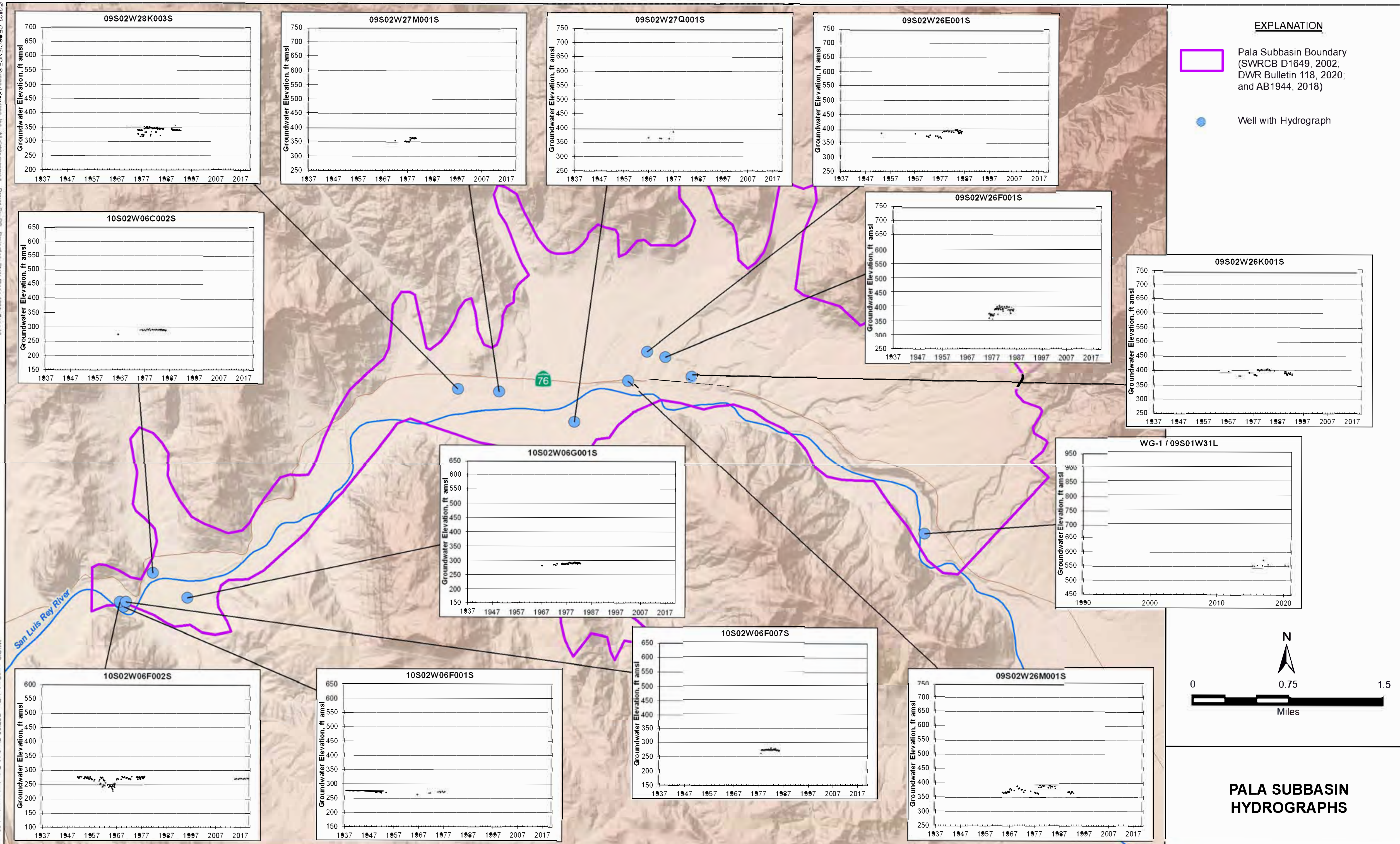
Jan-22

PAUMA VALLEY GSA

FIGURE 3-14

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



PALA SUBBASIN HYDROGRAPHS

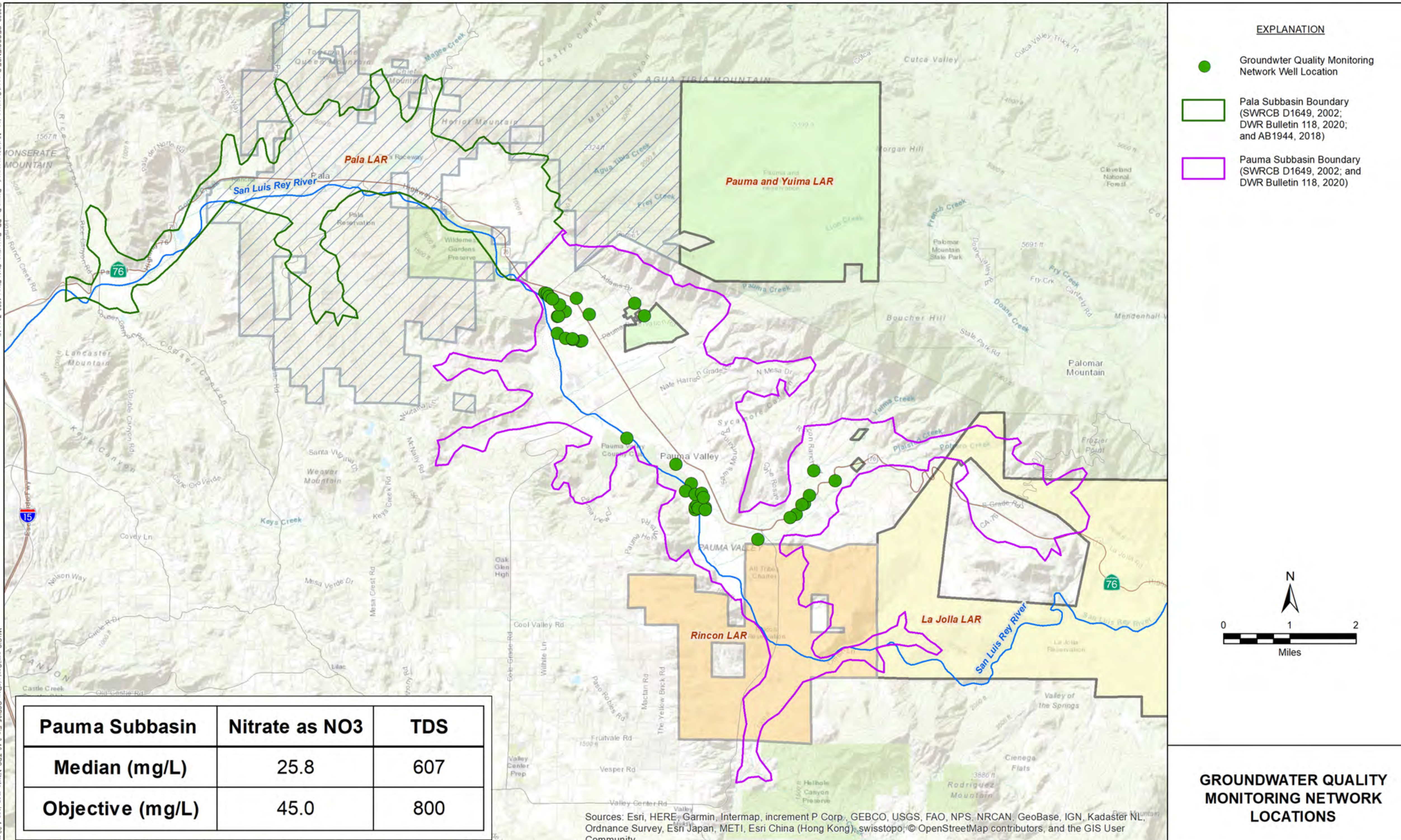
Jan-22

PAUMA VALLEY GSA

FIGURE 3-15

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

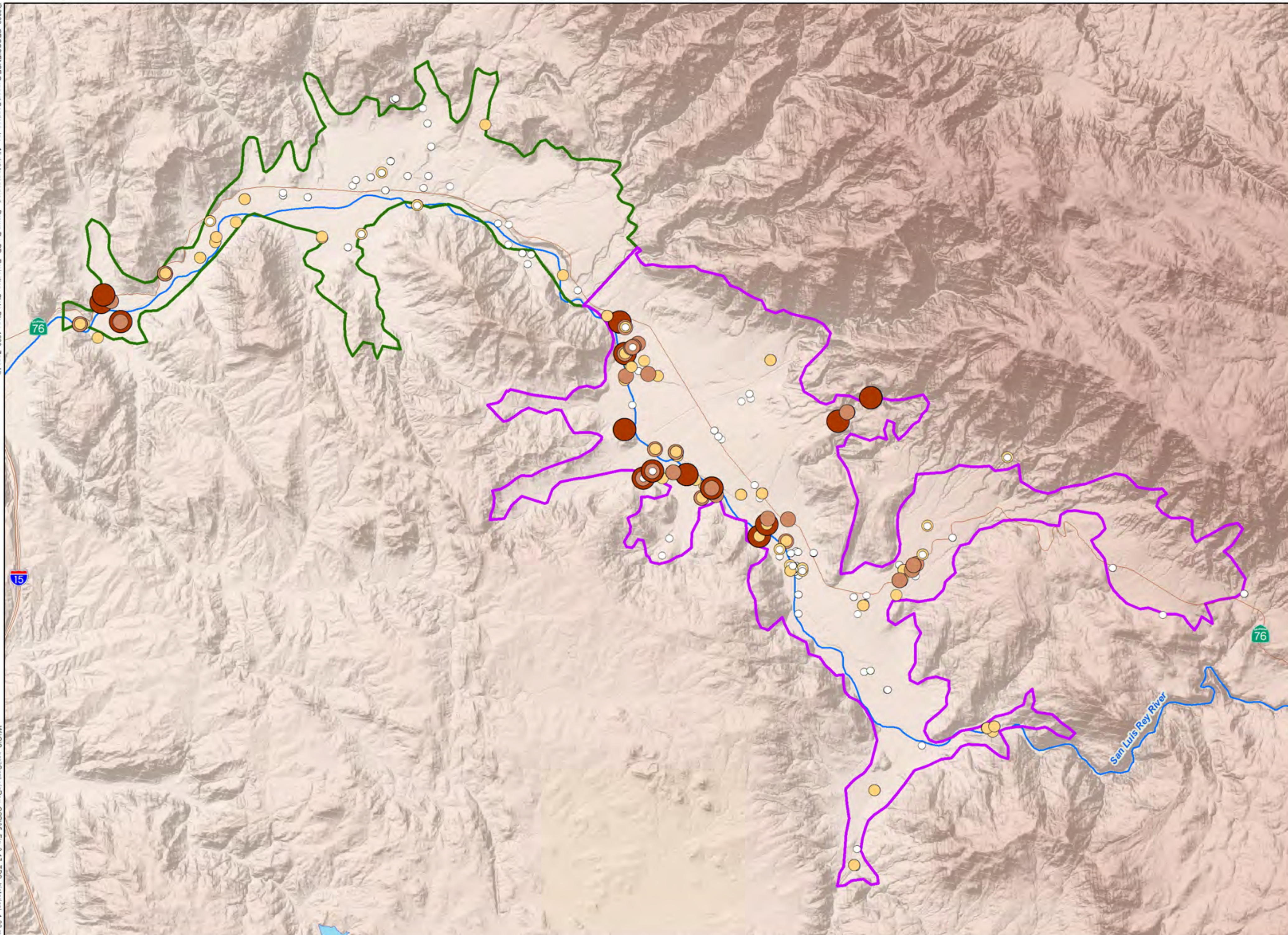
GEOSCIENCE



Pauma Subbasin	Nitrate as NO3	TDS
Median (mg/L)	25.8	607
Objective (mg/L)	45.0	800

GROUNDWATER QUALITY MONITORING NETWORK LOCATIONS

Jan-22



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

TDS Concentration, mg/L
(Source: Calif. Division of Drinking Water's (DDW's) water quality analyses database, 2017) (1952-2017)

- 0 - 500
- 500 - 750
- 750 - 1,000
- 1,000 - 2,500

Primary Maximum Contaminant Level for TDS = 1,000 mg/L

N

0 1.25 2.5
Miles

TOTAL DISSOLVED SOLIDS CONCENTRATIONS - HISTORICAL

W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-17_TDS_historical_1-22.mxd

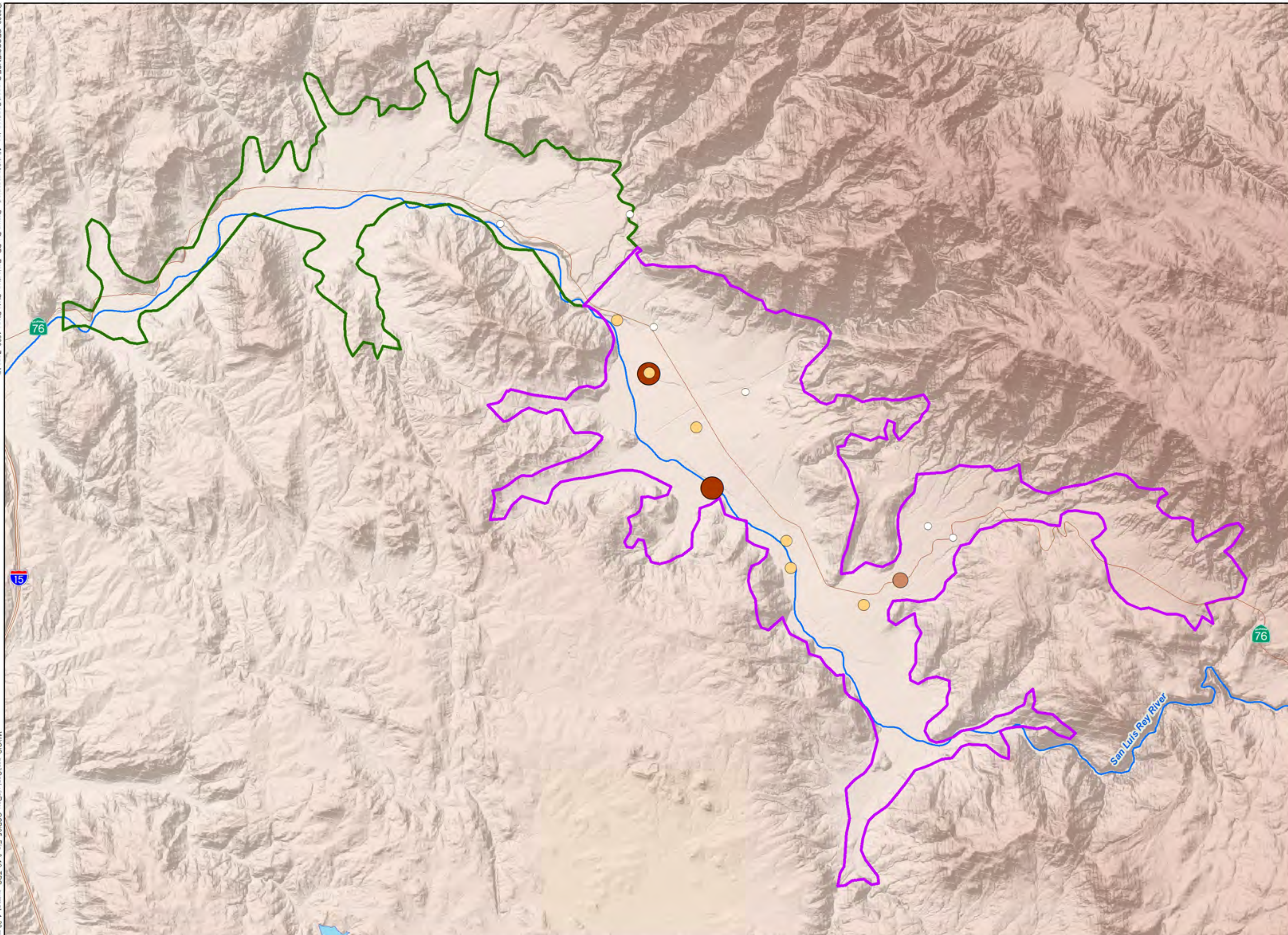
Jan-22

PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 3-17

GEOSCIENCE



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

TDS Concentration, mg/L (Source: Field Survey, March 2021)

- 0 - 500
- 500 - 800
- 800 - 1,000
- 1,000 - 2,500

Primary Maximum Contaminant Level for TDS = 1,000 mg/L

TOTAL DISSOLVED SOLIDS CONCENTRATIONS - CURRENT

W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-18_TDS_current_1-22.mxd

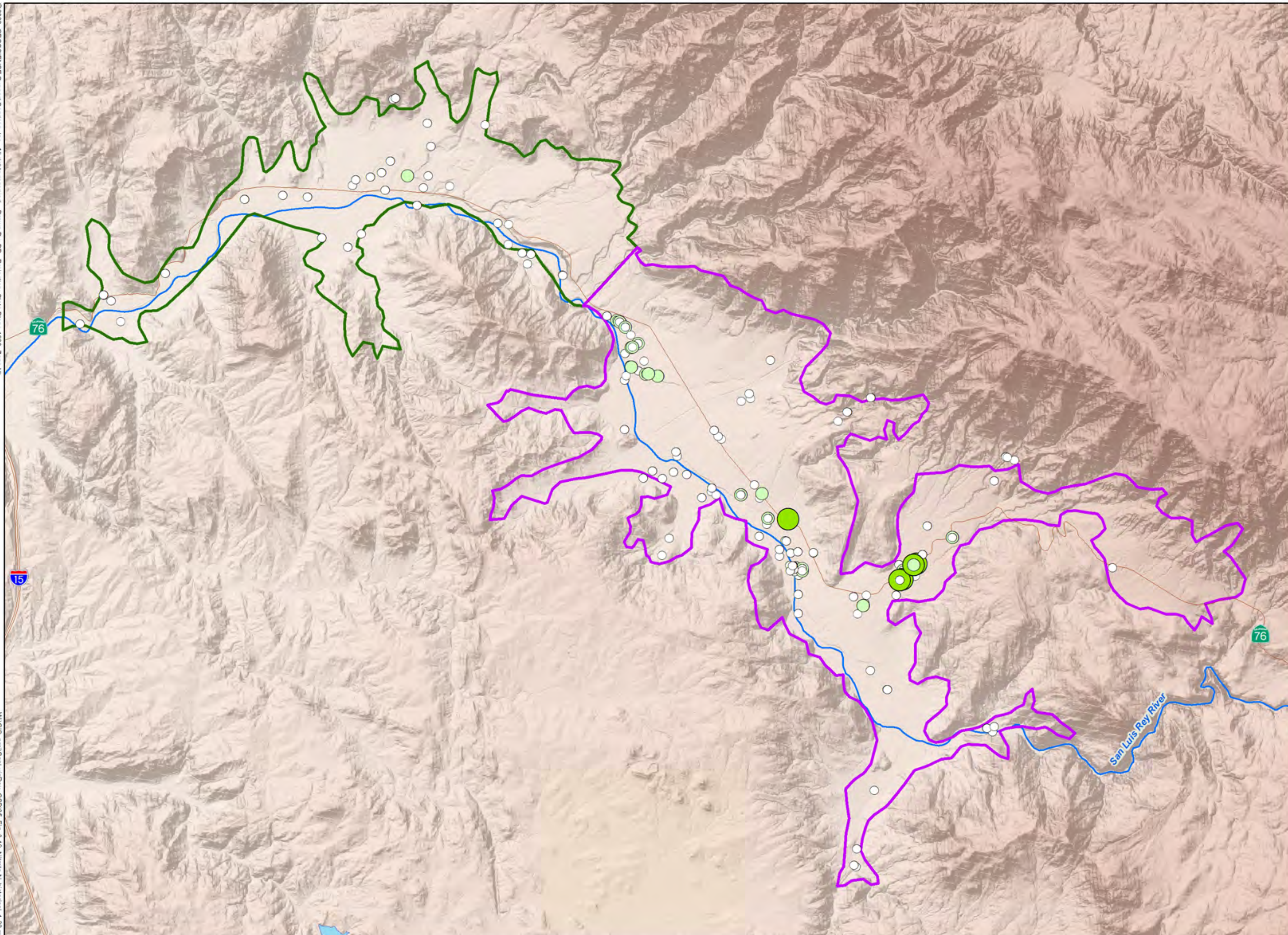
Jan-22

PAUMA VALLEY GSA

FIGURE 3-18

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Nitrate (as N), mg/L
(Source: Calif. Division of Drinking Water's (DDW's) water quality analyses database, 2017) (1952-2017)

- 0 - 10
- 10 - 20
- 20 - 30

Primary Maximum Contaminant Level for Nitrate (as N) = 10 mg/L

NITRATE CONCENTRATIONS - HISTORICAL

W:\GIS_proj\SanLuisRey_GSP\35_Fig_3-19_Nitrate-N_historical_1-22.mxd

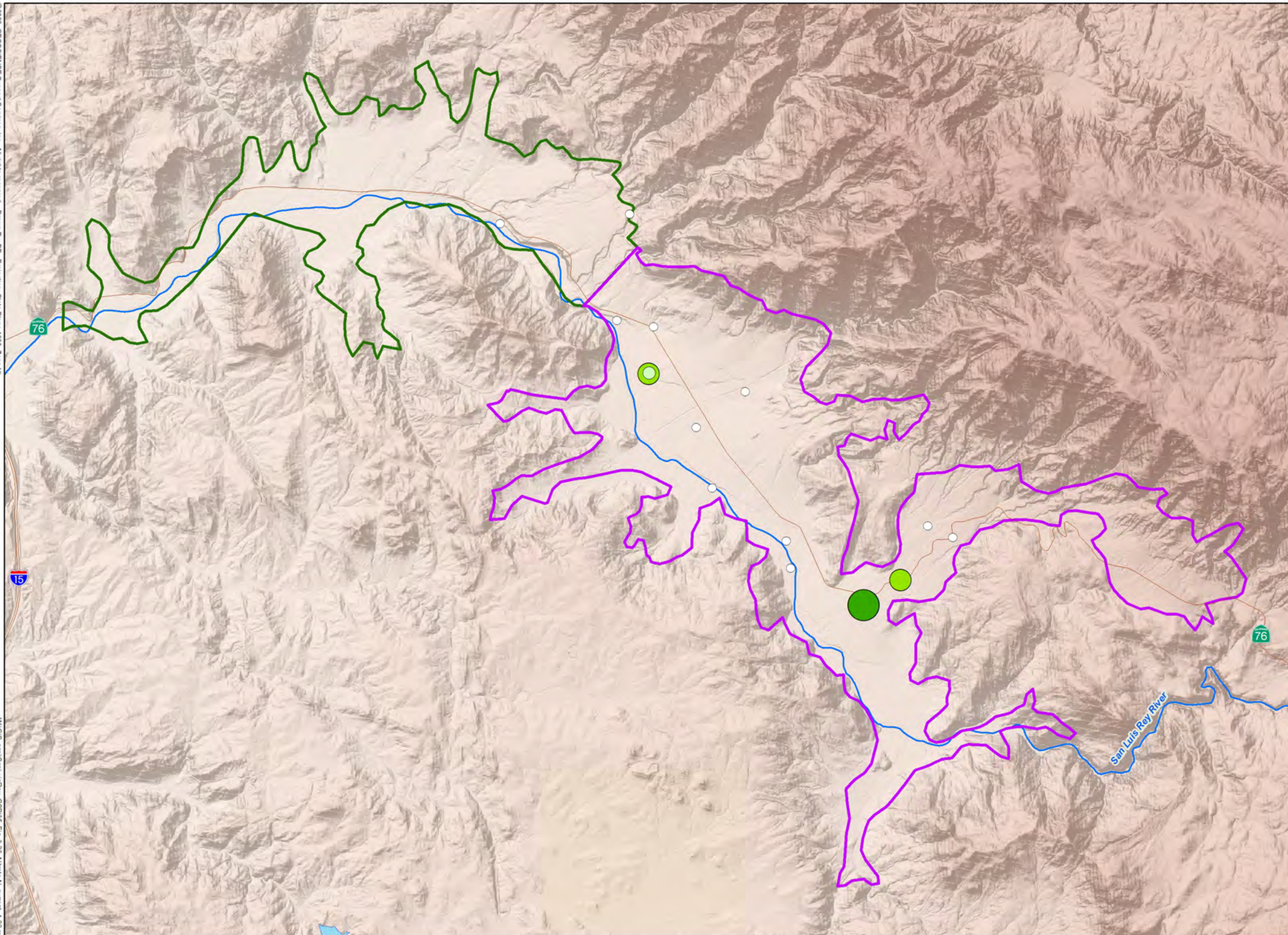
Jan-22

PAUMA VALLEY GSA

FIGURE 3-19

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Nitrate (as N), mg/L
(Source: Field Survey, March 2021)

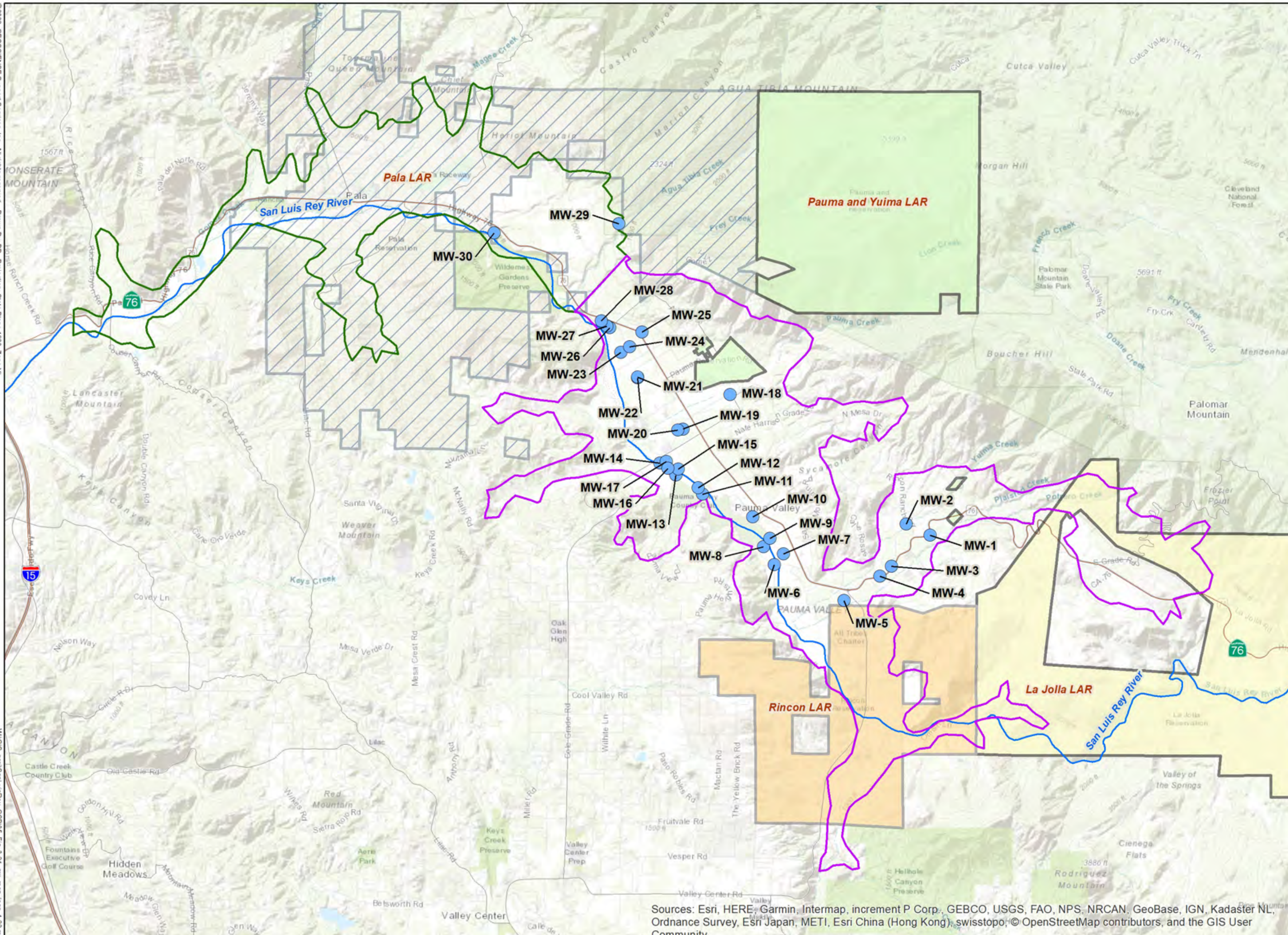
- 0 - 10
- 10 - 20
- 20 - 30
- 30 - 40

Primary Maximum Contaminant Level for Nitrate (as N) = 10 mg/L

NITRATE CONCENTRATIONS - CURRENT

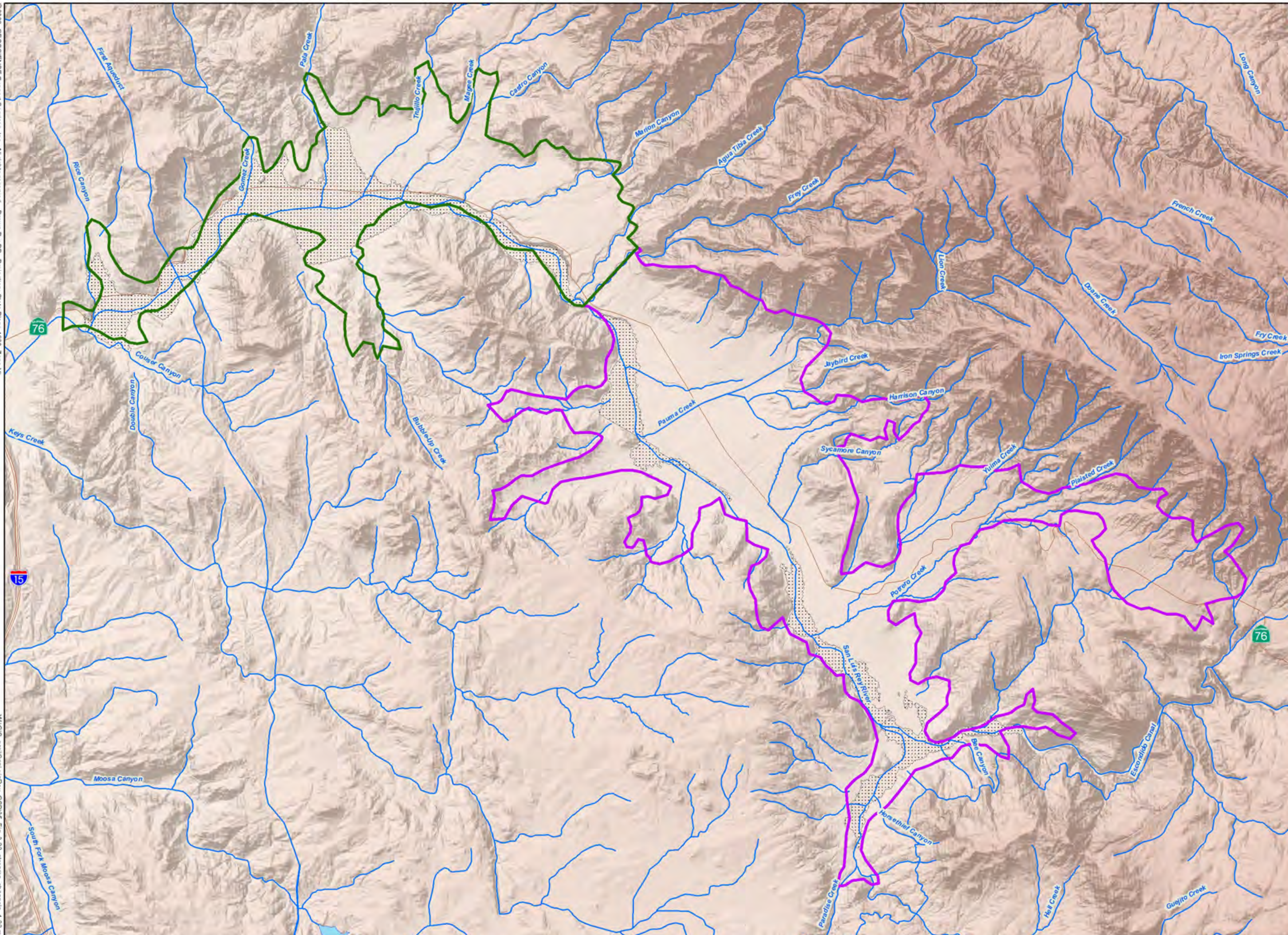
W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-20_Nitrate-N_current_1-22.mxd

Jan-22



INITIAL GROUNDWATER MONITORING NETWORK LOCATIONS

Jan-22



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EXPLANATION

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Estimated Depth to Groundwater Less Than 50 ft (represents location for potential interconnected surface waters, as suggested by the Nature Conservancy. Additional information needs to be collected to verify actual areas of interconnected groundwater / surface water)

N

0 1.25 2.5

Miles

STREAMS AND CHANNELS

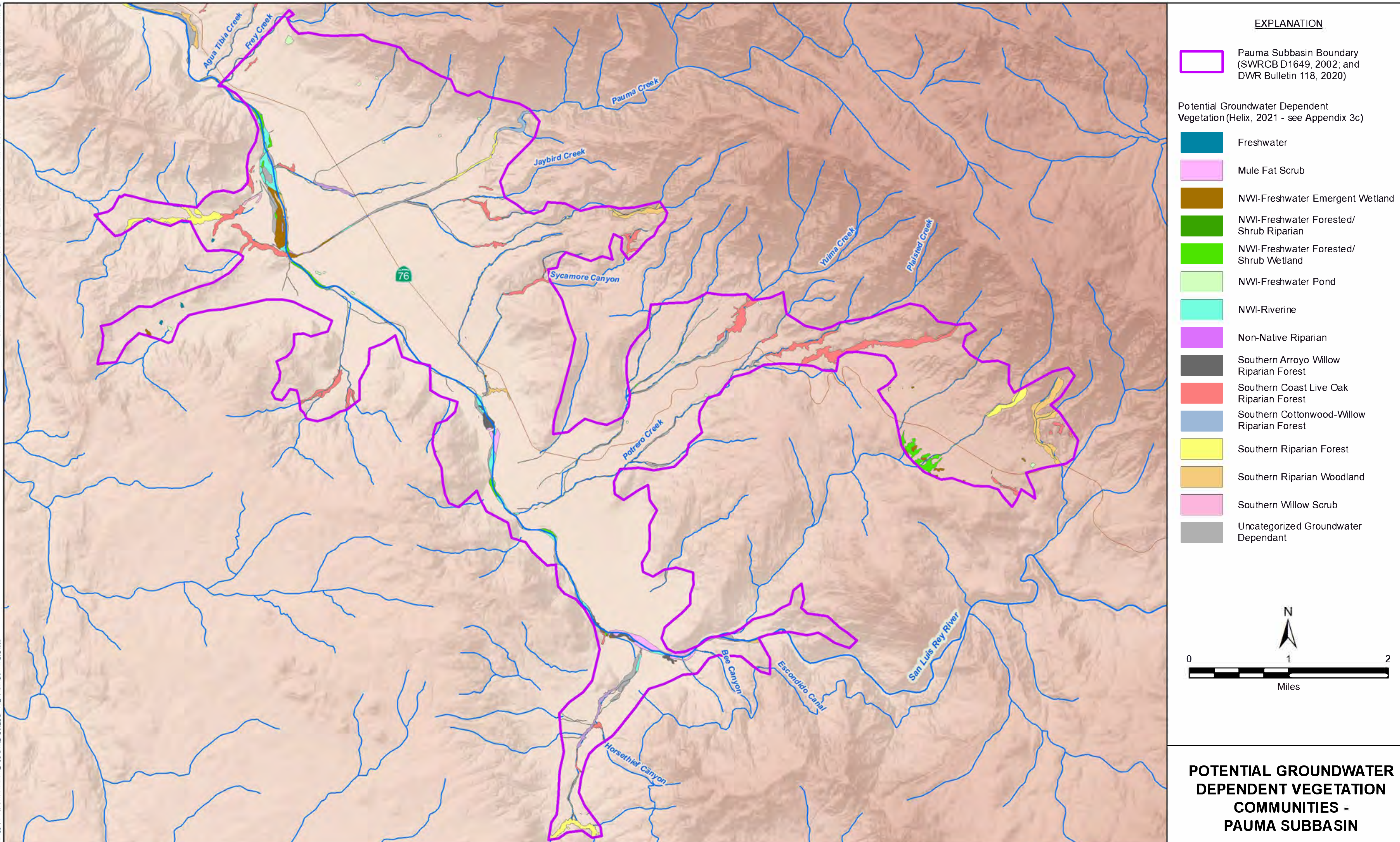
Jan-22

PAUMA VALLEY GSA

FIGURE 3-22

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE



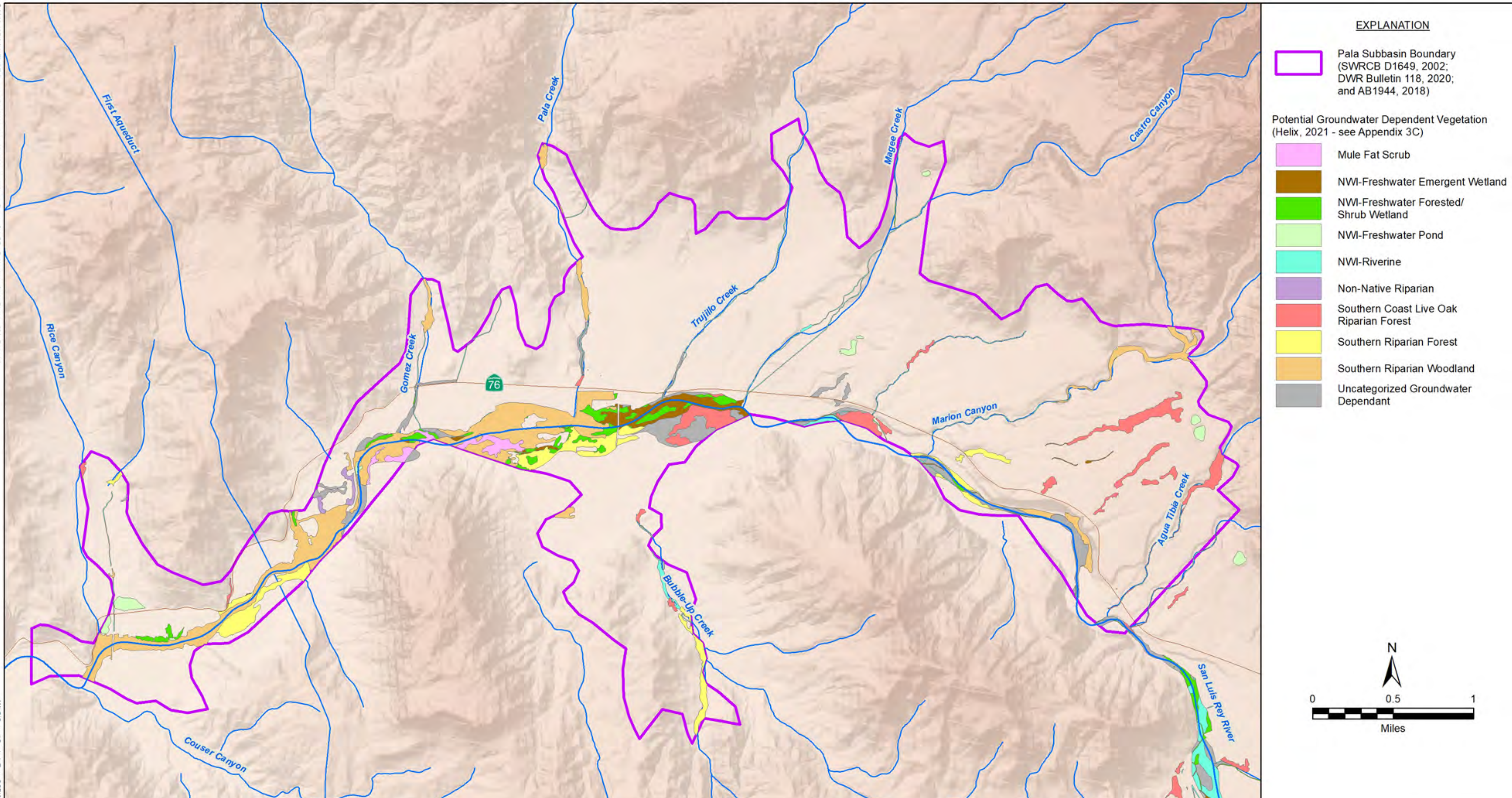
W:\GIS_proj\SanLuisRey_GSP\Fig_3-23_Pauma_vegetation_1-22.mxd

POTENTIAL GROUNDWATER DEPENDENT VEGETATION COMMUNITIES - PAUMA SUBBASIN

Jan-22

FIGURE 3-23

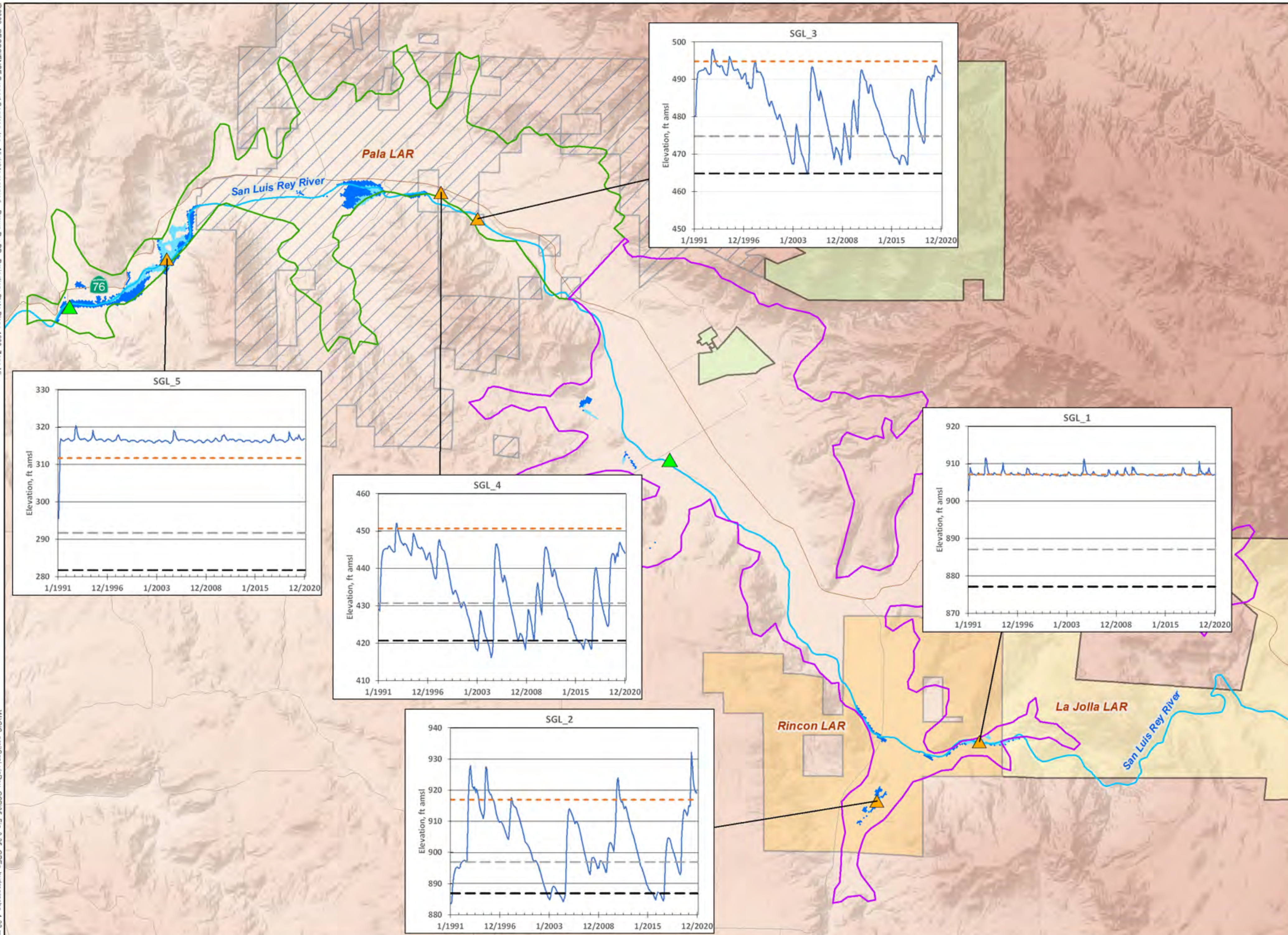
GEOSCIENCE



POTENTIAL GROUNDWATER DEPENDENT VEGETATION COMMUNITIES - PALA SUBBASIN

W:\GIS_proj\SanLuisRey_GSP\05_Fig_3-24_Pala_vegetation_1-22.mxd

Jan-22



EXPLANATION

Modeled Areas of Shallow Groundwater within Areas of Potential Groundwater Dependent Vegetation Communities

< 20 ft (represents extinction depth of most deep-rooted riparian vegetation (Maddock et al., 2012))

20 - 30 ft (30 ft represents the depth suggested by the Nature Conservancy to be used in identification of potential GDEs. Additional information needs to be collected to verify actual extent of GDEs)

SGL-1 Simulated Groundwater Levels Hydrograph in Relation to Land Surface in the Area of Shallow Groundwater

Surface Flow Measurement Location

Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)

Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Land Area Representation (BIA, 2020)

La Jolla LAR

Pala LAR

Pauma and Yuima LAR

Rincon LAR

Groundwater Elevation

Land Surface

20ft Below Land Surface

30ft Below Land Surface

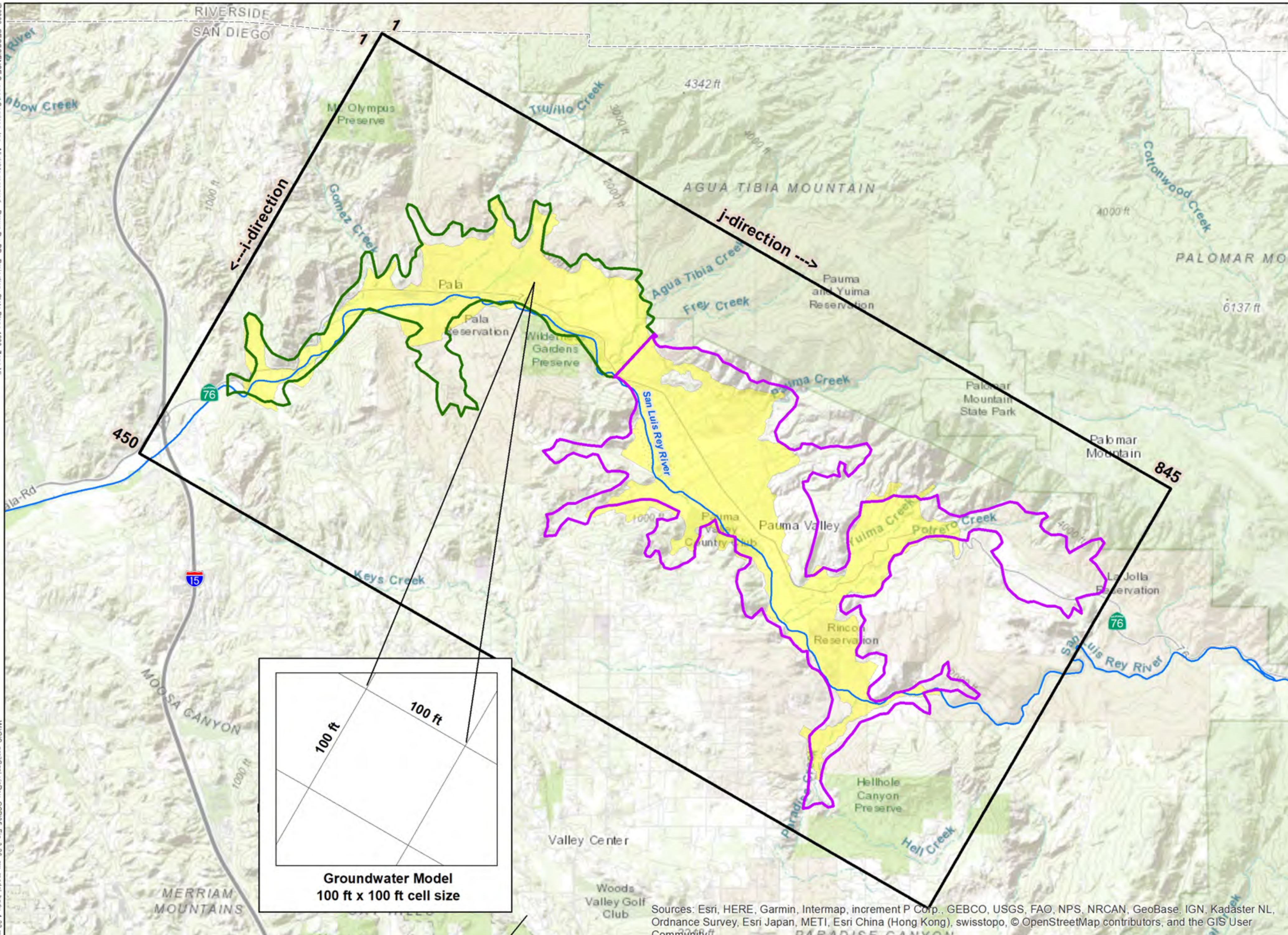
N

0 1 2

Miles

AREAS OF POTENTIAL GROUNDWATER DEPENDENT ECOSYSTEMS (GDEs)

Jan-22



EXPLANATION

- Upper San Luis Rey Groundwater Model (USLRGM) Boundary 450 X 845 X 3 Layers = 1,140,750 cells
- Upper San Luis Rey Groundwater Model (USLRGM) Active Model Area
- Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)
- Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, © OpenStreetMap contributors, and the GIS User Community

 Drawn By: DB Projection: State Plane 1983, Zone VI

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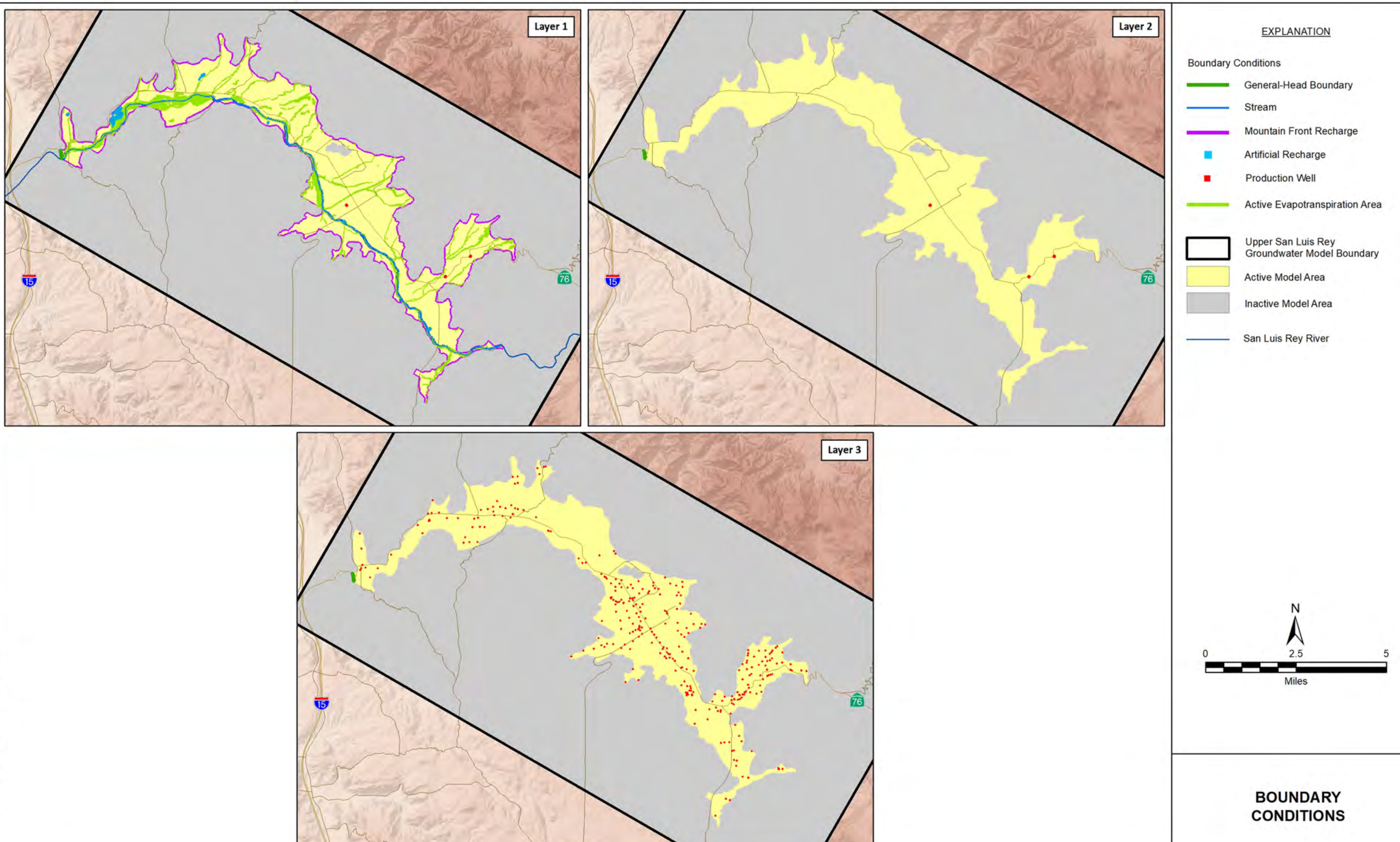
UPPER SAN LUIS REY GROUNDWATER MODEL BOUNDARY (USLRGM)



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BOUNDARY CONDITIONS

Jan-22

PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 3-27

GEOSCIENCE

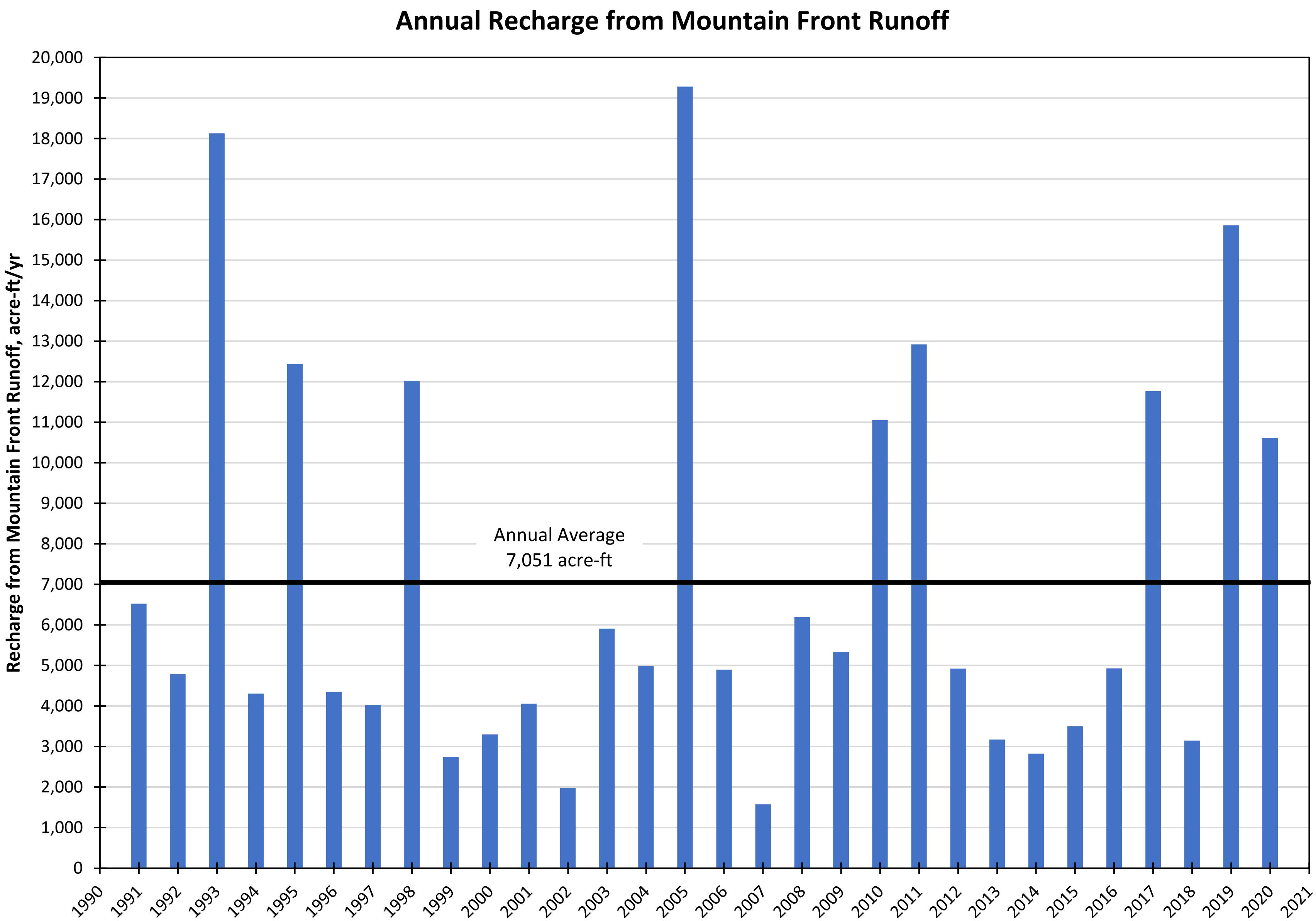

Annual Recharge from Mountain Front Runoff
Recharge from Mountain Front Runoff, acre-ft/yr
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
11,000
12,000
13,000
14,000
15,000
16,000
17,000
18,000
19,000
20,000
Annual Average
7,051 acre-ft
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-28

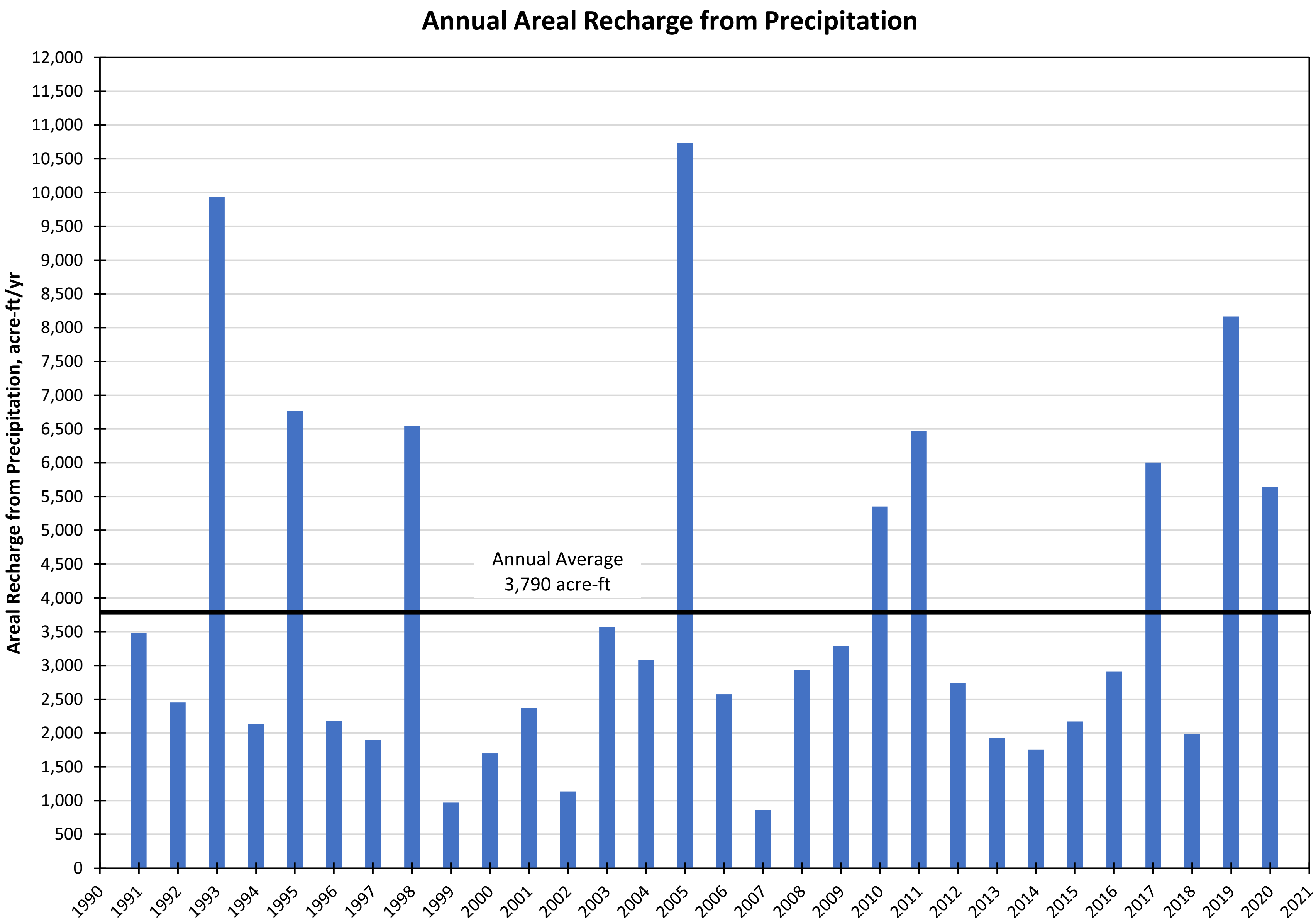

Annual Areal Recharge from Precipitation
Areal Recharge from Precipitation, acre-ft/yr
Annual Average
3,790 acre-ft
0
500
1,000
1,500
2,000
2,500
3,000
3,500
4,000
4,500
5,000
5,500
6,000
6,500
7,000
7,500
8,000
8,500
9,000
9,500
10,000
10,500
11,000
11,500
12,000
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-29

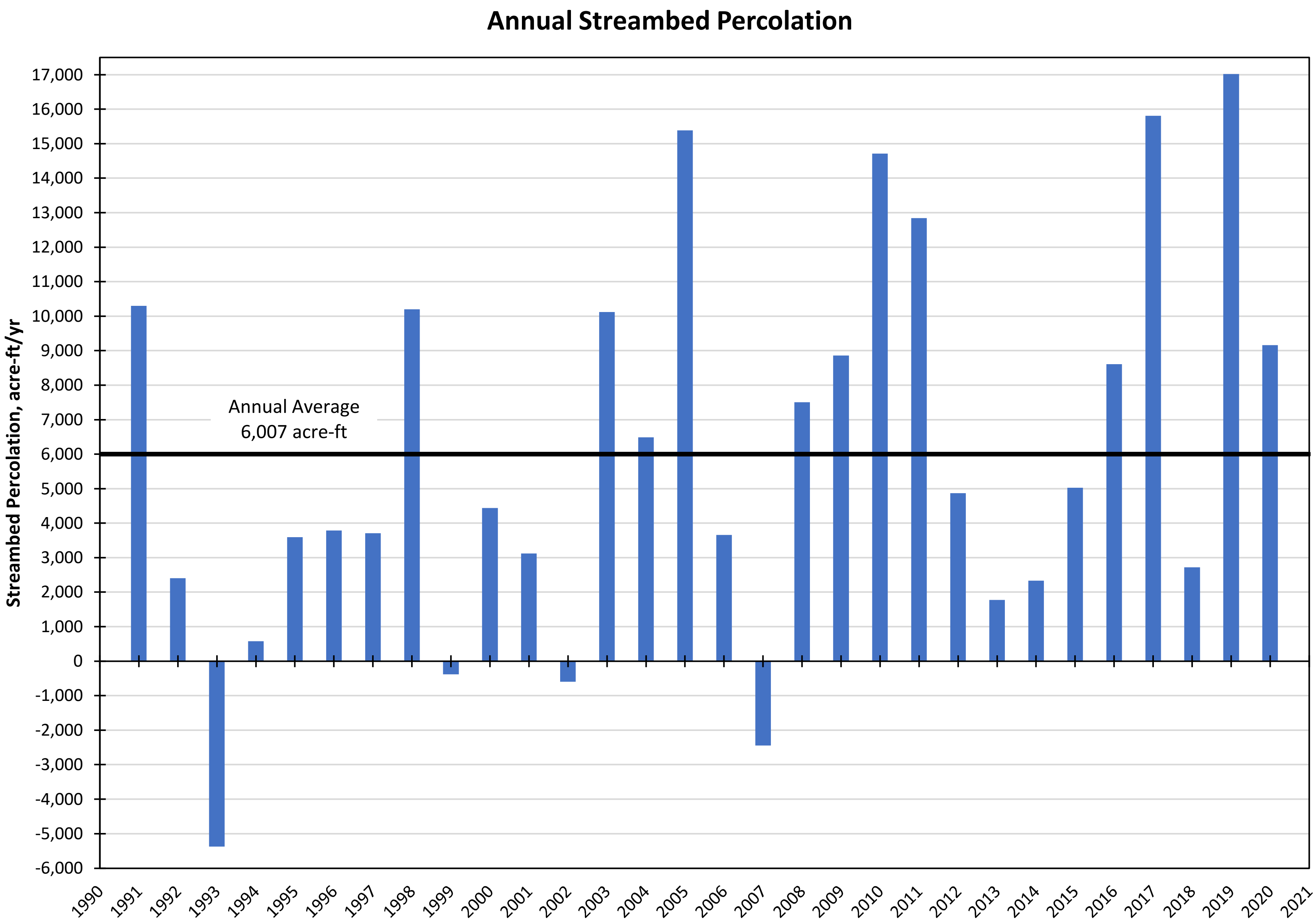

Annual Streambed Percolation
Streambed Percolation, acre-ft/yr
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-1,000
-2,000
-3,000
-4,000
-5,000
-6,000
Annual Average
6,007 acre-ft
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-30

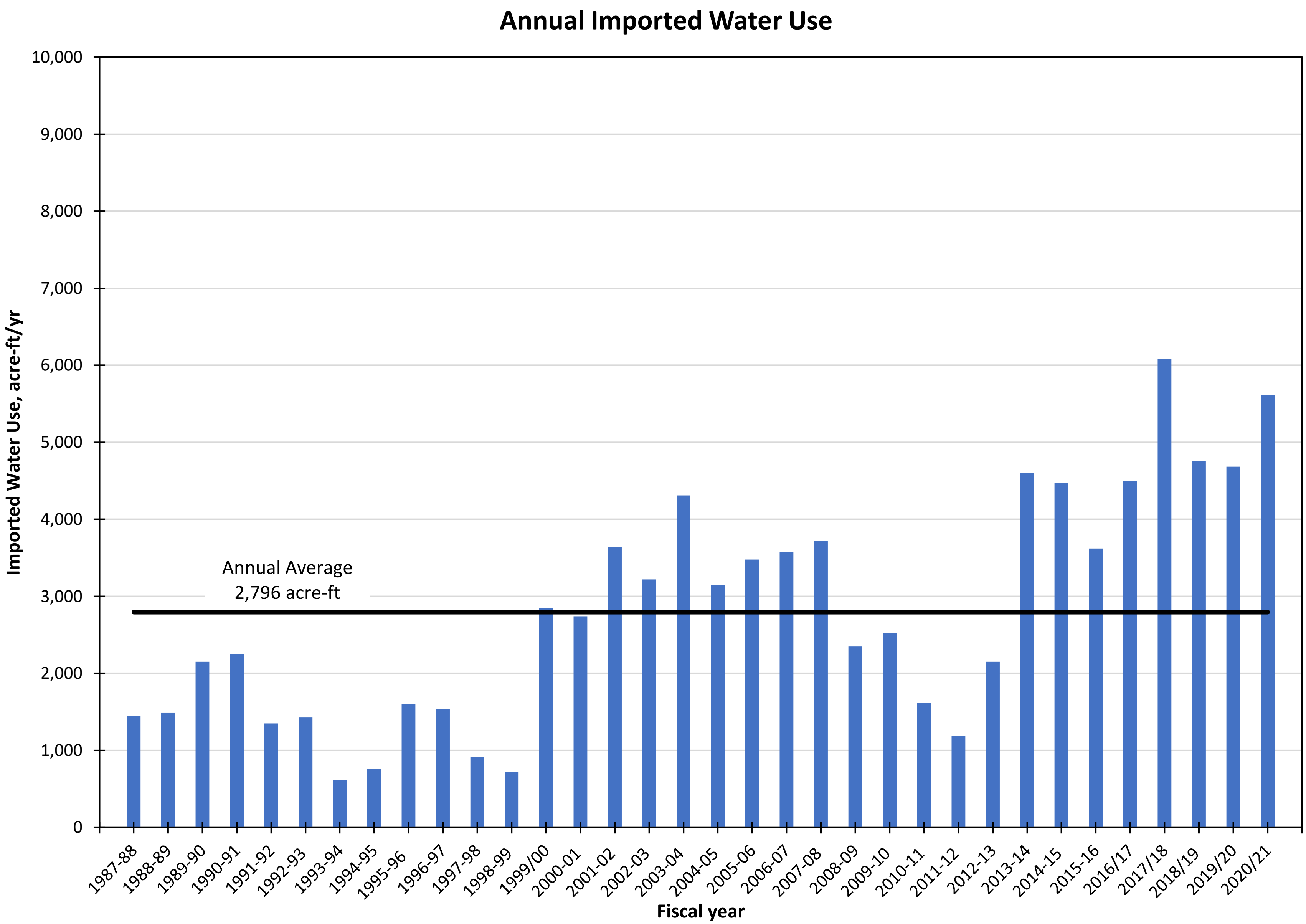

Annual Imported Water Use
Imported Water Use, acre-ft/yr
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Annual Average
2,796 acre-ft
1987-88
1988-89
1989-90
1990-91
1991-92
1992-93
1993-94
1994-95
1995-96
1996-97
1997-98
1998-99
1999/00
2000-01
2001-02
2002-03
2003-04
2004-05
2005-06
2006-07
2007-08
2008-09
2009-10
2010-11
2011-12
2012-13
2013-14
2014-15
2015-16
2016/17
2017/18
2018/19
2019/20
2020/21
Fiscal year

Figure 3-31

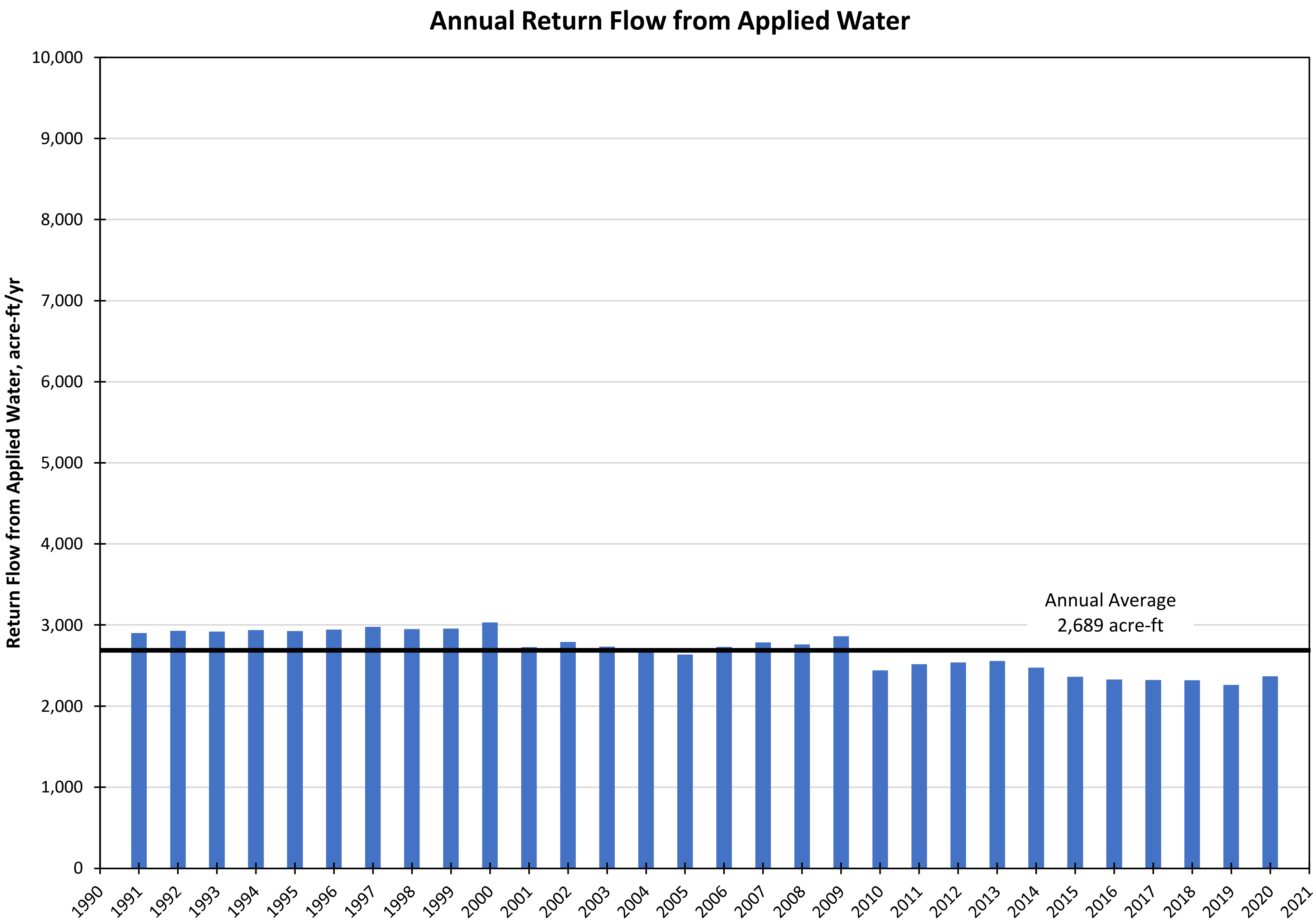

Annual Return Flow from Applied Water
Return Flow from Applied Water, acre-ft/yr
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
Annual Average
2,689 acre-ft
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-32

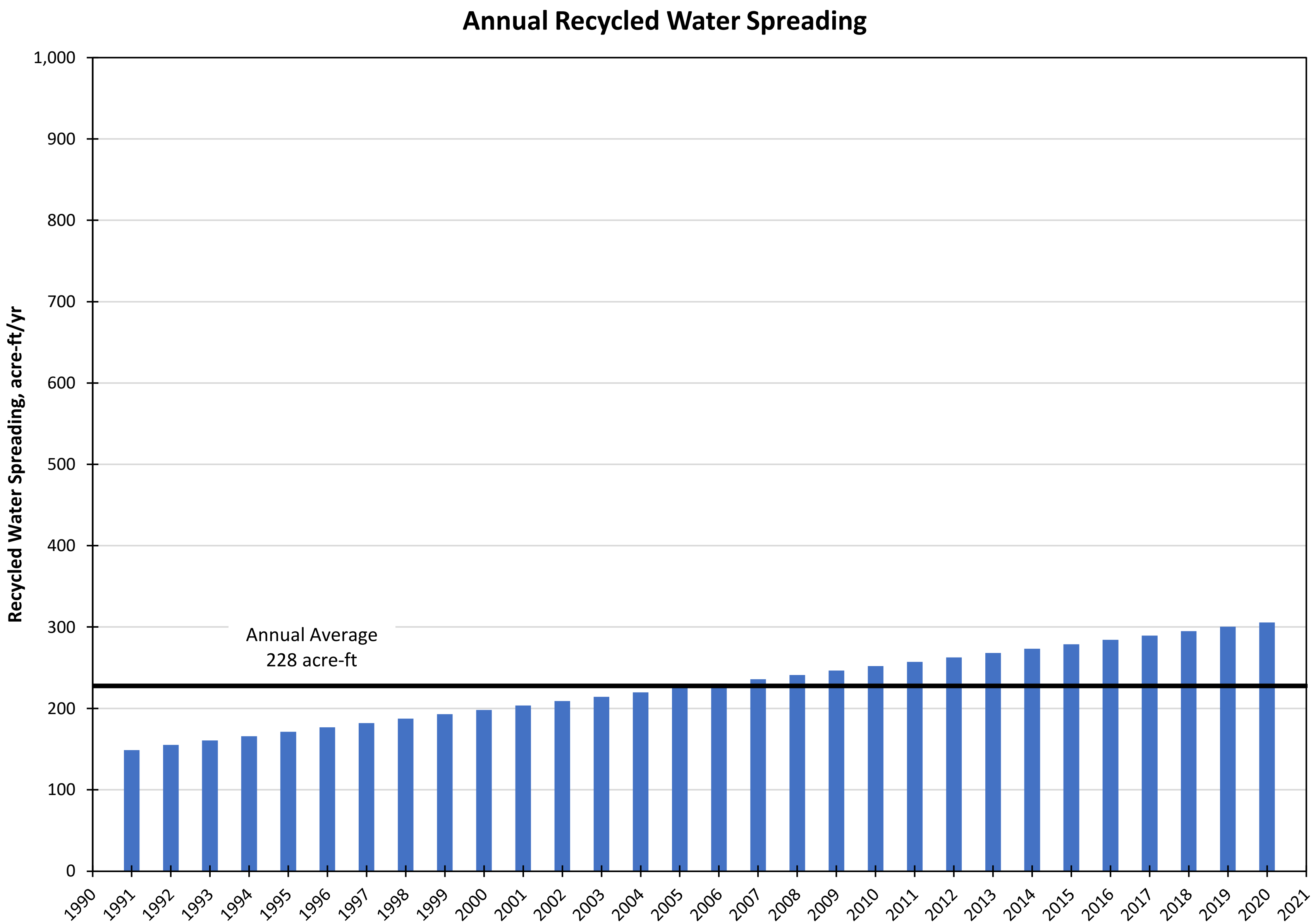
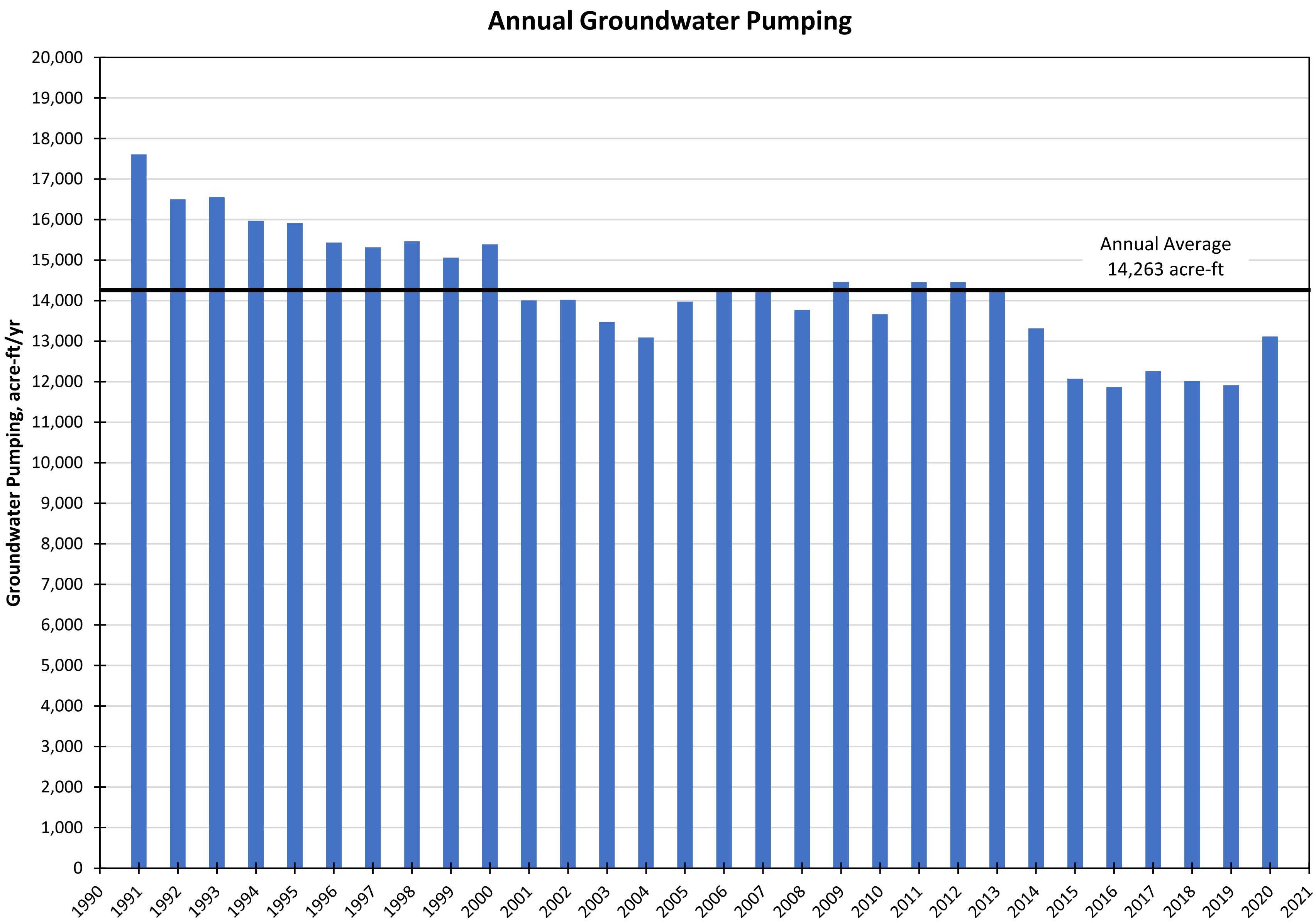

Annual Recycled Water Spreading
Recycled Water Spreading, acre-ft/yr
1,000
900
800
700
600
500
400
300
200
100
0
Annual Average
228 acre-ft
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-33


Annual Groundwater Pumping
Groundwater Pumping, acre-ft/yr
Annual Average
14,263 acre-ft
20,000
19,000
18,000
17,000
16,000
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
1990
1991
1992
1993
1994
1995
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2016
2017
2018
2019
2020
2021

Figure 3-34

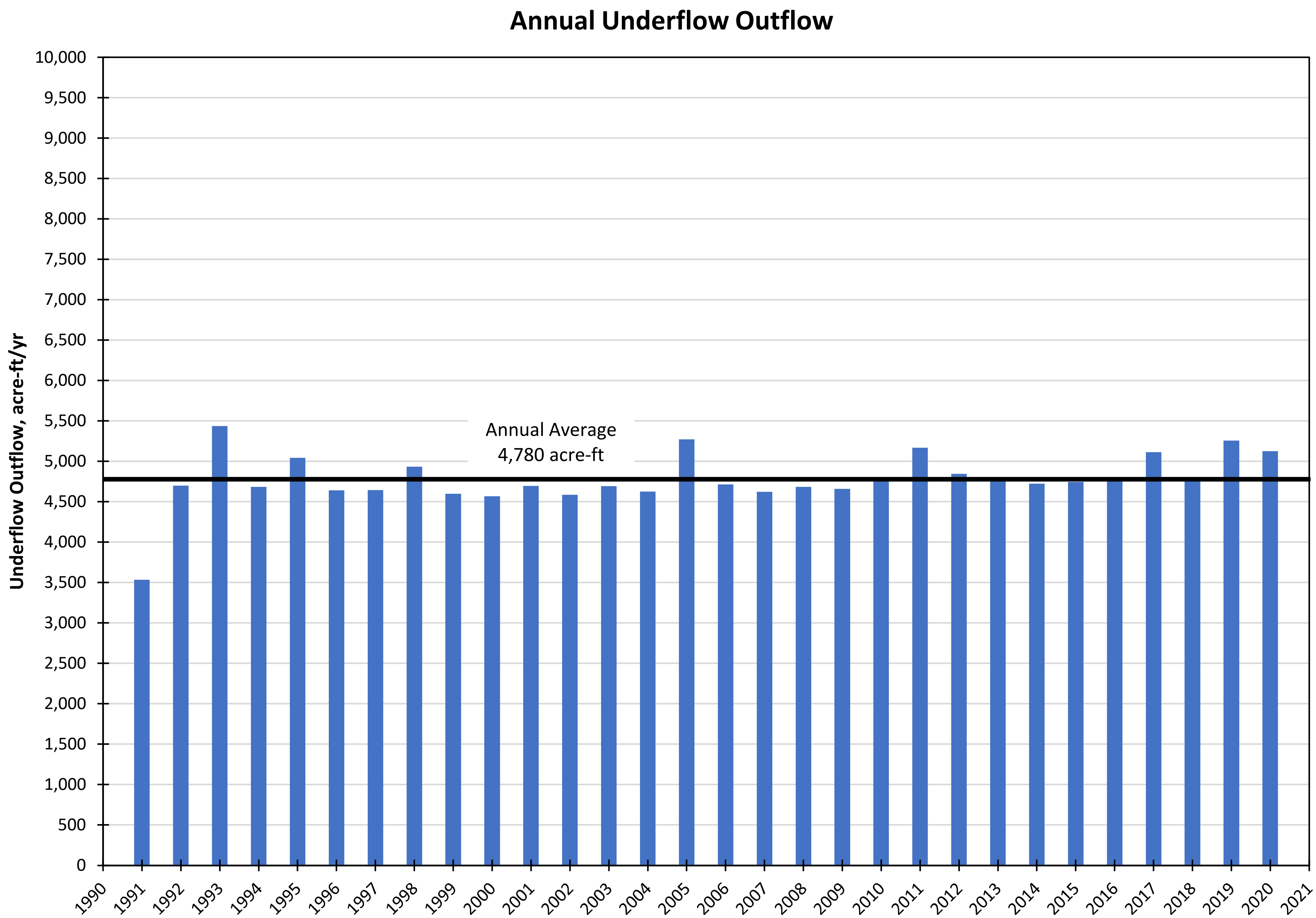

Annual Underflow Outflow
Underflow Outflow, acre-ft/yr
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Annual Average
4,780 acre-ft
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021

Figure 3-35

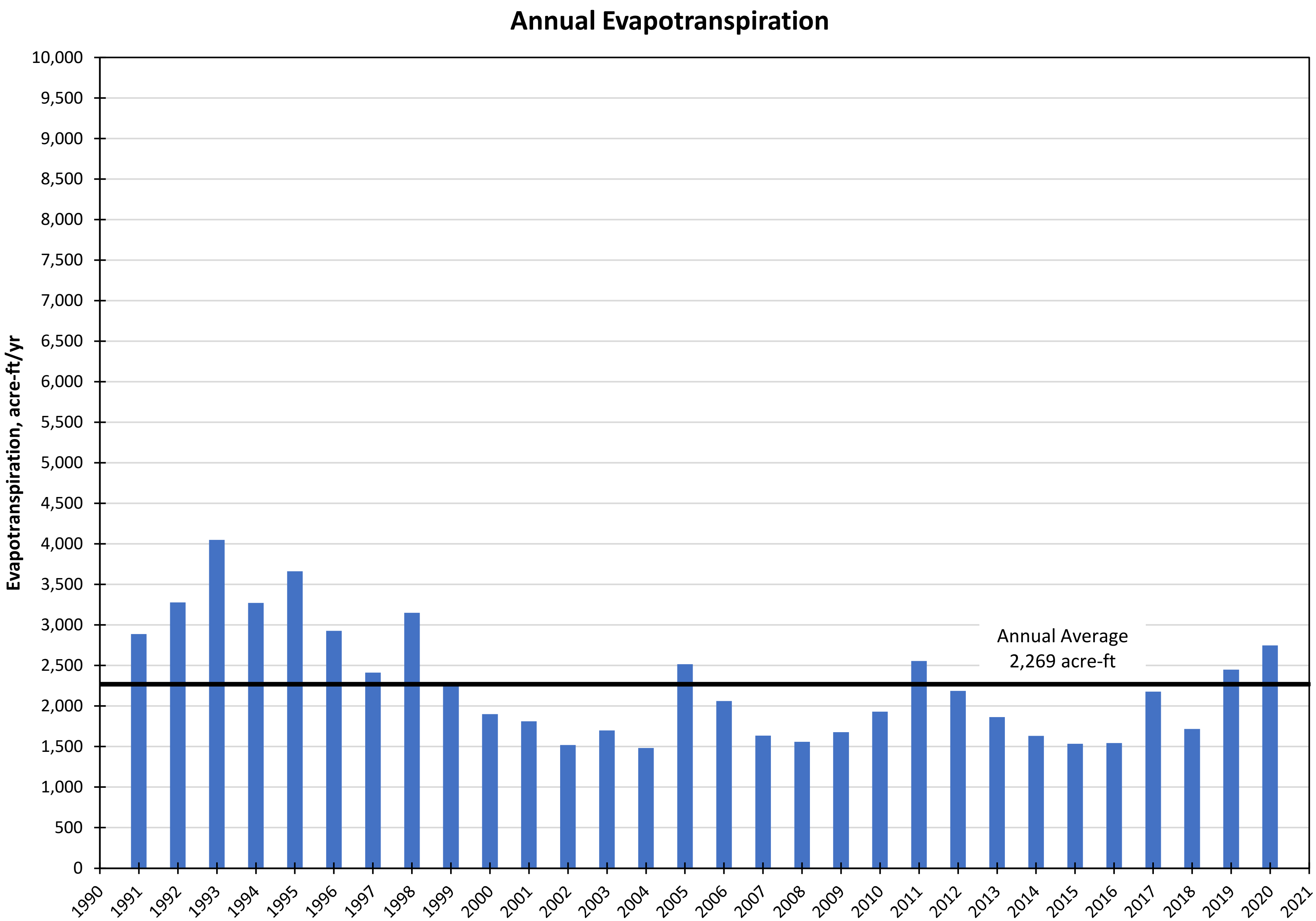
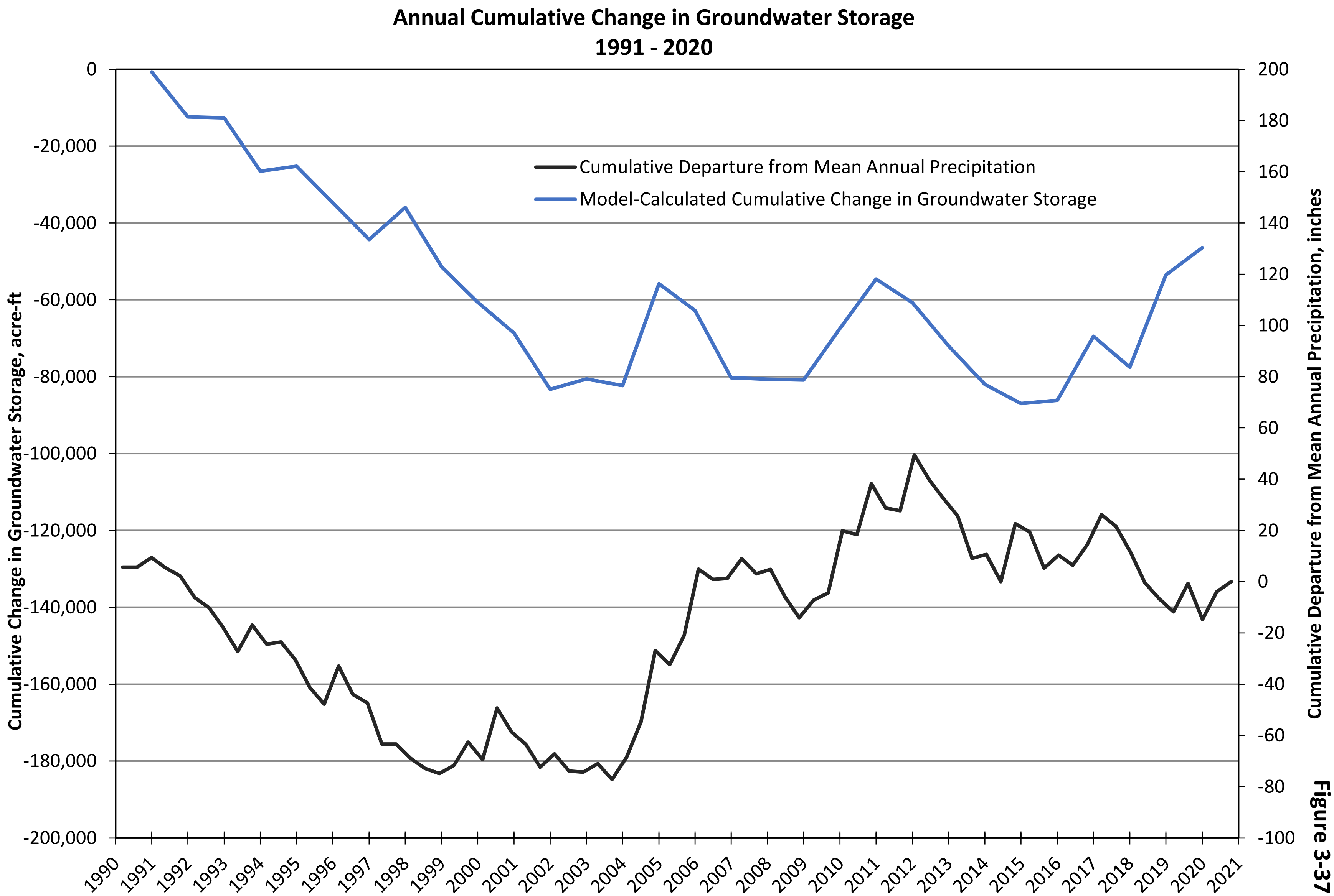

Annual Evapotranspiration
Evapotranspiration, acre-ft/yr
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
Annual Average
2,269 acre-ft

Figure 3-36


Annual Cumulative Change in Groundwater Storage
1991 - 2020
Cumulative Departure from Mean Annual Precipitation
Model-Calculated Cumulative Change in Groundwater Storage
Cumulative Change in Groundwater Storage, acre-ft
Cumulative Departure from Mean Annual Precipitation, inches
0
-20,000
-40,000
-60,000
-80,000
-100,000
-120,000
-140,000
-160,000
-180,000
-200,000
200
180
160
140
120
100
80
60
40
20
0
-20
-40
-60
-80
-100
1990
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
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2004
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2014
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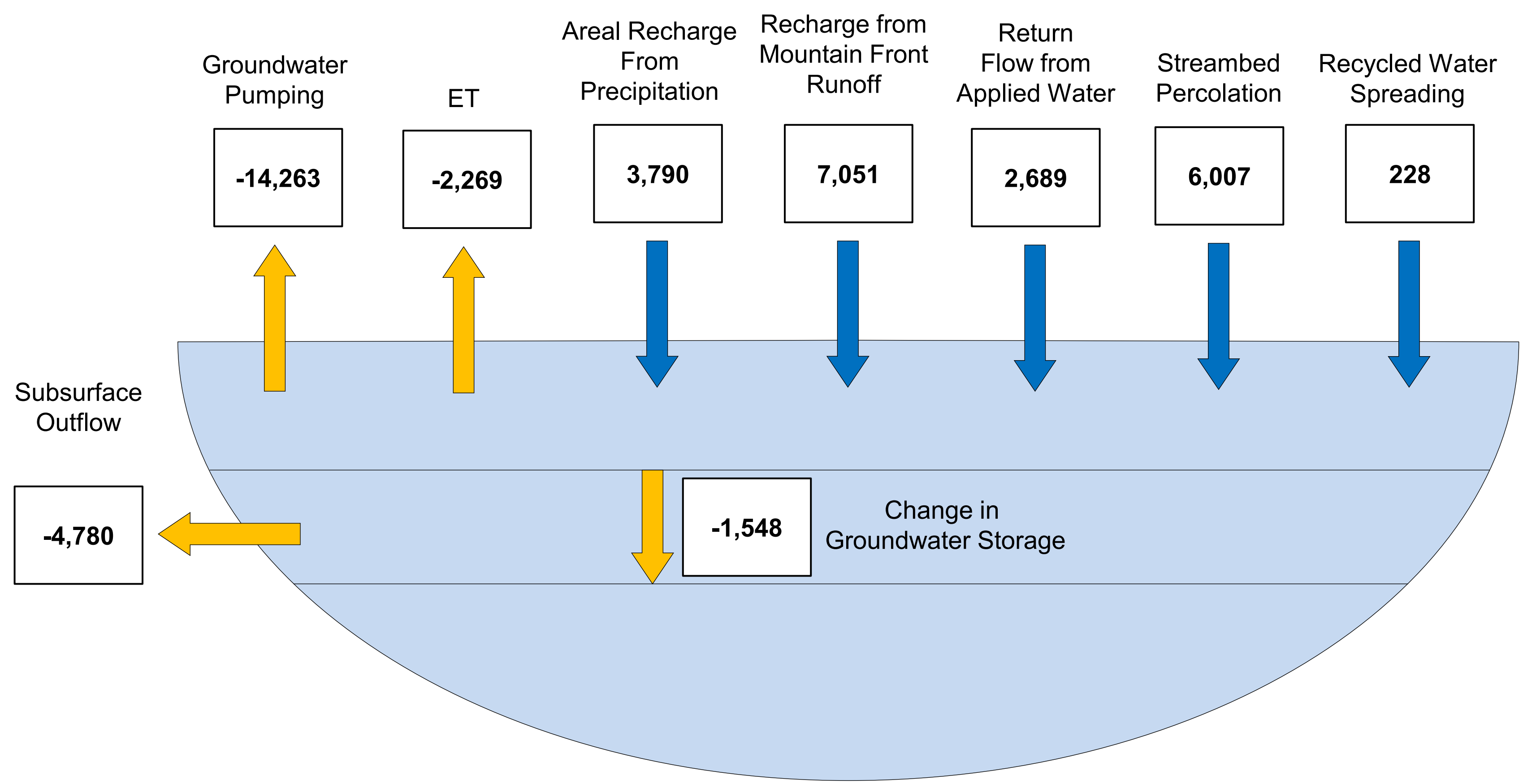
2016
2017
2018
2019
2020
2021

Figure 3-37



All values in acre-ft/yr
Note: Negative (-) denotes outflow/decrease
Positive(+) denotes inflow/increase

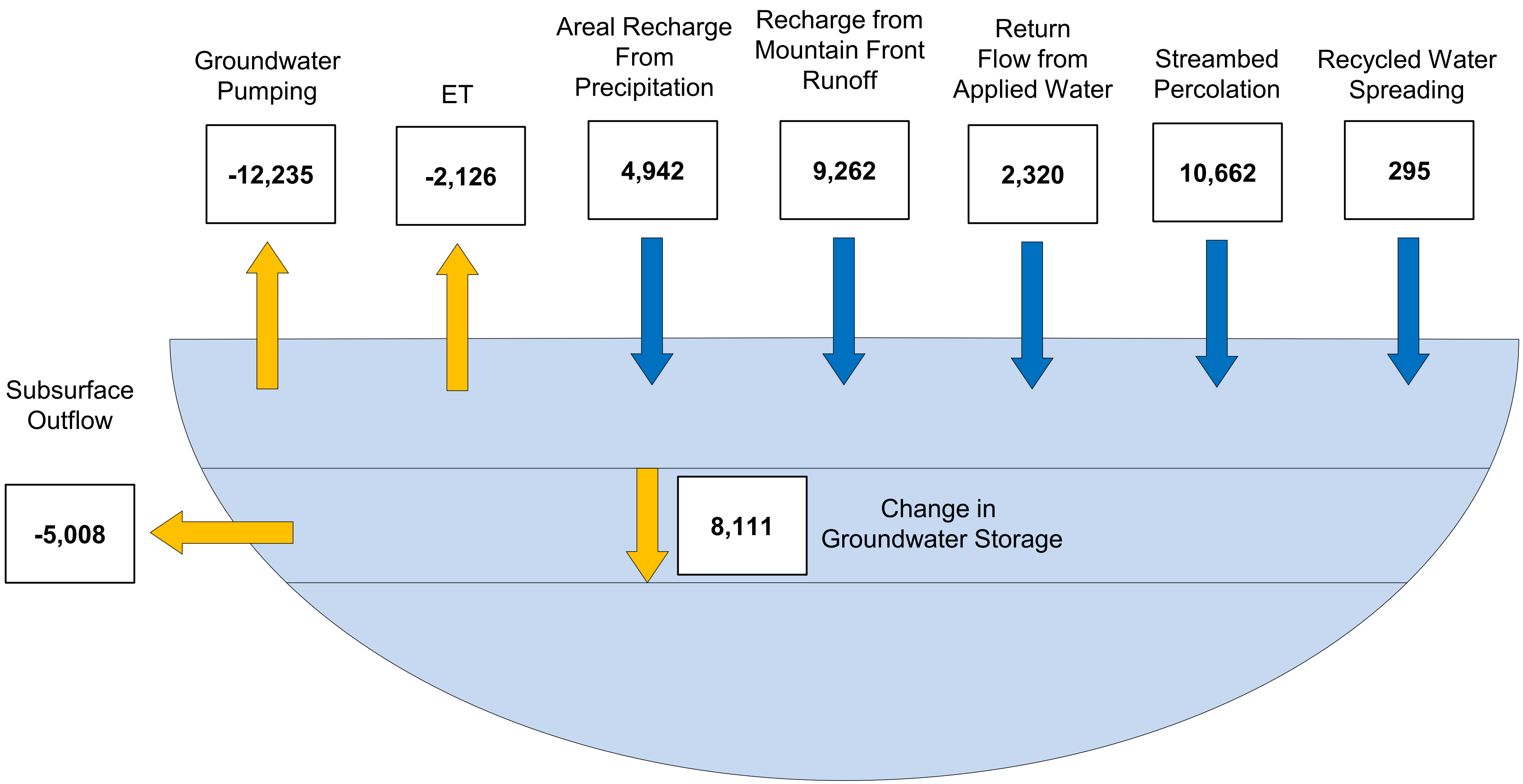
Historical Groundwater Budget (1991-2020)

\\srv02\geoscience\GSSI\Projects\Yuima MWD\USLR GSP\d_Reports\8) Admin Draft GSP\Figures Drawn By: AA

Jan-22

Pauma Valley GSA
Upper San Luis Rey Valley Groundwater Sustainability Plan

FIGURE 3-38

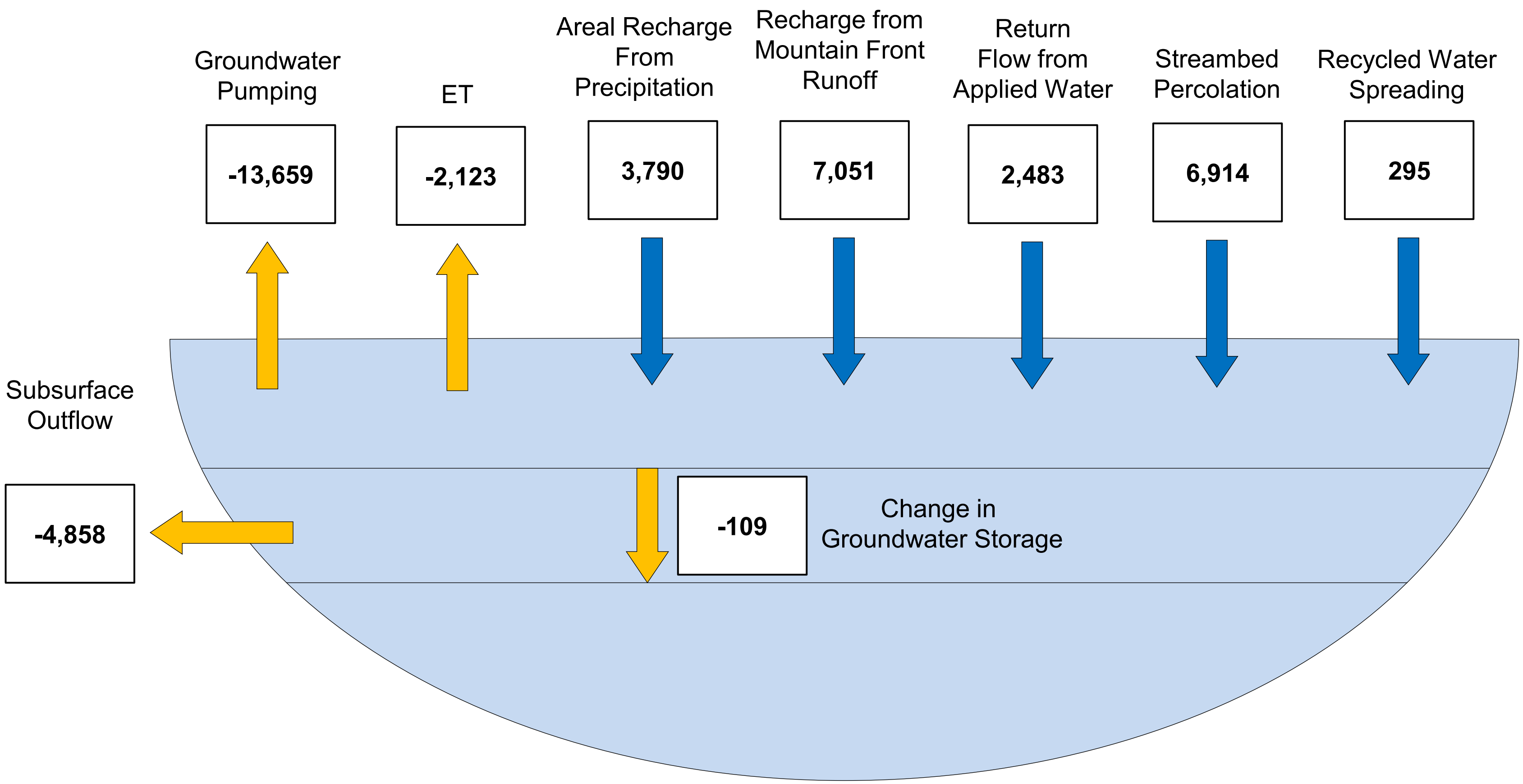


All values in acre-ft/yr
Note: Negative (-) denotes outflow/decrease
Positive(+) denotes inflow/increase

Current Groundwater Budget (2016-2020)

\\srv02\geoscience\GSSI\Projects\Yuima MWD\USLR GSP\d_Reports\8) Admin Draft GSP\Figures Drawn By: AA

Jan-22



All values in acre-ft/yr
Note: Negative (-) denotes outflow/decrease
Positive(+) denotes inflow/increase
Note: Based on hydrologic conditions from 1990 through 2020 (repeated twice)

Projected Groundwater Budget (2022-2081)

\\srv02\geoscience\GSSI\Projects\Yuima MWD\USLR GSP\d_Reports\8) Admin Draft GSP\Figures Drawn By: AA

Jan-22

Table 3-13: Water Quality Analytical Results

Upper San Luis Rey Sub-basin Initial Monitoring Network

San Luis Rey, California

		Monitoring Well Name:	MW-1	MW-2	MW-4	MW-4 DUP	MW-5	MW-6	MW-9	MW-9 DUP	MW-12	MW-18	MW-18 Dup	MW-19	MW-21
		Sample Collection Date:	24-Mar-21	25-Mar-21	24-Mar-21	24-Mar-21	24-Mar-21	24-Mar-21	25-Mar-21	25-Mar-21	25-Mar-21	29-Mar-21	29-Mar-21	29-Mar-21	25-Mar-21
Constituent	Method	Units	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result	Result
Aluminum	EPA 200.7	µg/L	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50
Arsenic, Total	EPA 200.8	µg/L	< 2.0	< 200	< 2.0	2	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Boron, Dissolved	EPA 200.7	mg/L	< 100	< 2.0	< 100	< 100	< 100	< 100	< 200	< 200	< 200	< 200	< 200	< 200	200
Calcium	EPA 200.7	mg/L	65	89	150	150	130	110	74	75	190	13	13	87	57
Calcium, Dissolved	EPA 200.7	mg/L	63	75	140	150	120	100	70	70	180	12	12	83	52
Chloride, Dissolved	EPA 300.0	mg/L	51	81	160	160	130	130	83	84	260	18	18	78	81
Chromium, Total	EPA 200.8	µg/L	< 1.0	2.4	1.2	1.1	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hardness, Total	SM2340B/EPA 200.7	mg/L	240	270	570	580	500	430	290	300	780	38	37	330	190
Iron, Dissolved	EPA 200.7	µg/L	< 100	< 200	< 100	< 100	< 100	< 100	< 200	< 200	< 200	< 200	< 200	< 200	< 200
Magnesium	EPA 200.7	mg/L	19	24	48	49	41	39	25	26	73	1.2	1.2	27	10
Manganese, Dissolved	EPA 200.8	µg/L	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20	< 20
Nitrate as N	EPA 300.0	mg/L	9.3	8.7	21	21	32	3.4	2.5	2.6	2.8	< 0.20	< 0.20	9.8	10
Nitrite as N	EPA 300.0	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 1.0	< 0.1	< 0.1	< 0.1	< 0.1
Nitrate+Nitrite as N	EPA 300.0	mg/L	9.3	8.7	21	21	32	3.4	2.5	2.6	2.8	< 0.20	< 0.20	9.8	10
Nitrite as N, Dissolved	EPA 300.0	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Perchlorate	EPA 314.0	µg/L	< 4.0	--	4.9	4.7	6.1	--	--	--	< 4.0	--	--	--	--
pH (Field measured)	Water Quality Meter	pH	6.66	6.74	6.95	6.95	6.96	6.64	6.75	6.75	6.38	8.48	8.48	7.22	8.06
Phosphorus, Dissolved Total	SM 4500P B E	mg/L	0.075	0.055	0.057	0.060	0.063	0.055	0.060	0.080	< 0.050	0.23	0.080	0.083	< 0.050
Potassium, Dissolved	EPA 200.7	mg/L	5.8	6.9	6.6	6.9	6.3	4.7	3.8	3.7	5.8	< 2.0	< 2.0	4.6	2.0
Sodium, Dissolved	EPA 200.7	mg/L	35	43	58	58	52	65	52	51	120	57	58	35	82
Specific Conductance (E.C)	SM2510B	µmhos/cm	620	790	1,300	1,300	1,200	1,000	820	800	1,900	340	340	790	810
Specific Conductance (E.C) (Field Measured)	Water Quality Meter	µS/cm	595	749	1,311	1,311	1,164	1,007	794	794	1,855	405.6	406	800	846
Sulfate, Dissolved	EPA 300.0	mg/L	95	130	200	210	170	230	150	150	560	94	94	160	200
Temperature (Field Measured)	Water Quality Meter	° C	19.7	18.1	21.8	21.8	20.3	18.9	19.2	19.2	19.3	24.7	24.7	18.7	22.9
Total Dissolved Solids	SM2540C	mg/L	400	490	850	840	760	680	530	530	1,400	240	220	540	530
Turbidity (Field Measured)	Water Quality Meter	NTU	89.05	26.97	75.53	75.53	12.30	73.19	21.45	21.45	1.46	0.96	0.96	1.50	4.50
Zinc	EPA 200.8	µg/L	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50	< 50

Notes:

mg/L = Milligrams per Liter; µg/L = Micrograms per Liter

µmhos/cm = Micromhos per Centimeter = µS/cm = Microsiemens per Centimeter

NTU = Nephelometric Turbidity Units

° C = Degrees Celsius

-- indicates sample not analyzed for the constituent, or data not available

* Sample from MW-30 was collected from the storage tank (not from the well), so field parameters were not measured

Table 3-13: Water Quality Analytical Results

Upper San Luis Rey Sub-basin Initial Monitoring Network

San Luis Rey, California

		Monitoring Well Name:	MW-22	MW-25	MW-27	MW-29	MW-30
		Sample Collection Date:	25-Mar-21	25-Mar-21	24-Mar-21	24-Mar-21	3/24/2021*
Constituent	**Method**	**Units**	**Result**	**Result**	**Result**	**Result**	**Result**
Aluminum	EPA 200.7	µg/L	< 50	< 50	< 50	82	< 50
Arsenic, Total	EPA 200.8	µg/L	< 2.0	4.1	< 2.0	< 2.0	< 2.0
Boron, Dissolved	EPA 200.7	mg/L	< 200	< 200	< 100	150	< 100
Calcium	EPA 200.7	mg/L	170	34	92	< 1.0	43
Calcium, Dissolved	EPA 200.7	mg/L	160	33	89	< 1.0	42
Chloride, Dissolved	EPA 300.0	mg/L	180	33	58	15	37
Chromium, Total	EPA 200.8	µg/L	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Hardness, Total	SM2340B/EPA 200.7	mg/L	630	96	320	< 3.0	170
Iron, Dissolved	EPA 200.7	µg/L	< 200	< 200	< 100	< 100	< 100
Magnesium	EPA 200.7	mg/L	46	2.5	22	< 1.0	14
Manganese, Dissolved	EPA 200.8	µg/L	< 20	< 20	< 20	< 20	< 20
Nitrate as N	EPA 300.0	mg/L	23	1.6	4.7	< 0.20	4.2
Nitrite as N	EPA 300.0	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Nitrate+Nitrite as N	EPA 300.0	mg/L	23	1.6	4.7	< 0.20	4.2
Nitrite as N, Dissolved	EPA 300.0	mg/L	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Perchlorate	EPA 314.0	µg/L	--	--	--	--	--
pH (Field measured)	Water Quality Meter	pH	6.31	8.23	7.27	10.03	--
Phosphorus, Dissolved Total	SM 4500P B E	mg/L	< 0.050	< 0.050	< 0.050	< 0.050	0.057
Potassium, Dissolved	EPA 200.7	mg/L	5.9	2.6	4.4	< 1.0	4.5
Sodium, Dissolved	EPA 200.7	mg/L	63	78	53	43	37
Specific Conductance (E.C)	SM2510B	µmhos/cm	1,500	590	800	210	470
Specific Conductance (E.C) (Field Measured)	Water Quality Meter	µS/cm	1,360	615	791	221.6	--
Sulfate, Dissolved	EPA 300.0	mg/L	380	170	200	2.7	73
Temperature (Field Measured)	Water Quality Meter	° C	17.8	23.2	20.2	21.3	--
Total Dissolved Solids	SM2540C	mg/L	1,100	340	530	120	310
Turbidity (Field Measured)	Water Quality Meter	NTU	0.86	1.29	1.94	7.94	--
Zinc	EPA 200.8	µg/L	< 50	< 50	< 50	< 50	< 50

Notes:

mg/L = Milligrams per Liter; µg/L = Micrograms per Liter

µmhos/cm = Micromhos per Centimeter = µS/cm = Microsiemens per Centimeter

NTU = Nephelometric Turbidity Units

° C = Degrees Celsius

-- indicates sample not analyzed for the constituent, or data not available

* Sample from MW-30 was collected from the storage tank (not from the well), so field p

Table 3-14: Upper San Luis Rey Groundwater Subbasin Annual Groundwater Budget (1991 - 2020)

Calender Year	Areal Recharge from Precipitation	Recharge from Mountain Front Runoff	Return Flow from Applied Water	Streambed Percolation	Recycled Water Spreading	Total Inflow	Groundwater Pumping	Evapotranspiration	Subsurface Outflow	Total Outflow	Change in Groundwater Storage	Cumulative Change in Storage
	acre-ft						acre-ft				acre-ft	
1991	3,483	6,525	2,902	10,300	149	23,359	17,609	2,886	3,533	24,028	-669	-669
1992	2,452	4,787	2,929	2,401	155	12,724	16,497	3,278	4,697	24,471	-11,747	-12,416
1993	9,937	18,129	2,919	-5,376	160	25,769	16,556	4,048	5,437	26,041	-271	-12,688
1994	2,131	4,303	2,936	579	166	10,116	15,971	3,271	4,682	23,925	-13,809	-26,496
1995	6,766	12,440	2,925	3,596	171	25,898	15,913	3,663	5,042	24,618	1,280	-25,217
1996	2,174	4,347	2,942	3,788	177	13,428	15,434	2,928	4,640	23,002	-9,574	-34,791
1997	1,897	4,034	2,979	3,708	182	12,799	15,314	2,412	4,642	22,369	-9,570	-44,360
1998	6,541	12,027	2,951	10,200	187	31,907	15,460	3,151	4,933	23,544	8,363	-35,998
1999	970	2,746	2,955	-381	193	6,483	15,063	2,252	4,598	21,914	-15,431	-51,429
2000	1,697	3,296	3,033	4,438	198	12,662	15,388	1,899	4,568	21,855	-9,193	-60,622
2001	2,366	4,055	2,727	3,122	204	12,474	14,005	1,811	4,694	20,510	-8,036	-68,658
2002	1,133	1,980	2,790	-600	209	5,511	14,023	1,519	4,584	20,127	-14,615	-83,273
2003	3,566	5,909	2,733	10,119	214	22,541	13,476	1,697	4,691	19,864	2,677	-80,596
2004	3,075	4,981	2,695	6,486	220	17,457	13,093	1,481	4,624	19,198	-1,742	-82,338
2005	10,730	19,281	2,636	15,383	225	48,256	13,976	2,514	5,272	21,763	26,493	-55,844
2006	2,571	4,897	2,729	3,661	230	14,089	14,234	2,062	4,715	21,011	-6,922	-62,767
2007	858	1,571	2,787	-2,444	236	3,008	14,240	1,635	4,621	20,496	-17,487	-80,254
2008	2,933	6,195	2,760	7,503	241	19,632	13,772	1,558	4,684	20,014	-383	-80,637
2009	3,282	5,335	2,860	8,862	247	20,586	14,462	1,679	4,658	20,798	-212	-80,849
2010	5,354	11,055	2,442	14,709	252	33,812	13,664	1,929	4,805	20,398	13,415	-67,434
2011	6,472	12,918	2,517	12,842	257	35,008	14,458	2,555	5,167	22,180	12,828	-54,606
2012	2,739	4,920	2,539	4,867	263	15,328	14,456	2,187	4,846	21,489	-6,161	-60,767
2013	1,929	3,170	2,556	1,776	268	9,700	14,265	1,863	4,765	20,893	-11,193	-71,960
2014	1,756	2,821	2,475	2,330	273	9,655	13,319	1,632	4,723	19,673	-10,018	-81,977
2015	2,171	3,501	2,362	5,028	279	13,341	12,072	1,532	4,745	18,350	-5,009	-86,986
2016	2,913	4,924	2,327	8,607	284	19,055	11,868	1,542	4,791	18,201	854	-86,132
2017	6,004	11,770	2,323	15,808	290	36,195	12,262	2,178	5,113	19,553	16,641	-69,491
2018	1,984	3,150	2,319	2,718	295	10,465	12,020	1,715	4,755	18,490	-8,026	-77,517
2019	8,167	15,857	2,262	17,018	300	43,604	11,912	2,449	5,256	19,617	23,987	-53,530
2020	5,645	10,607	2,367	9,162	306	28,087	13,114	2,747	5,124	20,986	7,101	-46,429
Average 1991 to 2020	**3,790**	**7,051**	**2,689**	**6,007**	**228**	**19,765**	**14,263**	**2,269**	**4,780**	**21,313**	**-1,548**	

Table 3-15: Projected Upper San Luis Rey Groundwater Subbasin Annual Groundwater Budget (2022 - 2081)

Calendar Year	Areal Recharge from Precipitation	Recharge from Mountain Front Runoff	Return Flow from Applied Water	Streambed Percolation	Recycled Water Spreading	Total Inflow	Groundwater Pumping	Evapotranspiration	Subsurface Outflow	Total Outflow	Change in Groundwater Storage	Cumulative Change in Storage
	acre-ft						acre-ft				acre-ft	
2022	3,483	6,525	2,577	5,443	295	18,324	14,154	2,588	4,822	21,564	-3,240	-3,240
2023	2,452	4,787	2,577	5,842	295	15,953	13,946	2,241	4,760	20,946	-4,993	-8,234
2024	9,937	18,129	2,577	11,999	295	42,937	14,808	3,763	5,448	24,019	18,919	10,685
2025	2,131	4,303	2,577	2,122	295	11,429	14,388	2,848	4,754	21,990	-10,561	124
2026	6,766	12,440	2,577	8,236	295	30,314	14,599	3,361	5,099	23,059	7,255	7,380
2027	2,174	4,347	2,577	3,742	295	13,135	14,266	2,564	4,728	21,558	-8,422	-1,043
2028	1,897	4,034	2,577	3,376	295	12,178	13,972	2,215	4,733	20,920	-8,741	-9,784
2029	6,541	12,027	2,577	11,529	295	32,970	14,294	2,697	5,010	22,001	10,969	1,185
2030	970	2,746	2,577	-707	295	5,881	13,935	2,083	4,690	20,707	-14,826	-13,641
2031	1,697	3,296	2,577	4,072	295	11,938	13,517	1,839	4,661	20,016	-8,079	-21,719
2032	2,366	4,055	2,577	3,324	295	12,618	13,350	1,742	4,737	19,829	-7,211	-28,931
2033	1,133	1,980	2,577	-401	295	5,584	12,971	1,460	4,626	19,057	-13,473	-42,404
2034	3,566	5,909	2,577	10,469	295	22,816	13,027	1,626	4,731	19,384	3,432	-38,971
2035	3,075	4,981	2,577	6,747	295	17,675	12,723	1,423	4,665	18,810	-1,135	-40,106
2036	10,730	19,281	2,577	16,132	295	49,016	14,250	2,449	5,311	22,009	27,007	-13,099
2037	2,571	4,897	2,577	3,830	295	14,170	13,751	1,992	4,757	20,500	-6,330	-19,430
2038	858	1,571	2,577	-2,302	295	2,999	13,314	1,587	4,663	19,564	-16,565	-35,995
2039	2,933	6,195	2,577	7,592	295	19,592	13,154	1,528	4,728	19,410	182	-35,813
2040	3,282	5,335	2,577	8,931	295	20,420	13,251	1,654	4,701	19,605	815	-34,998
2041	5,354	11,055	2,320	14,653	295	33,677	13,457	1,917	4,849	20,223	13,455	-21,544
2042	6,472	12,918	2,320	12,946	295	34,951	13,953	2,528	5,181	21,662	13,289	-8,254
2043	2,739	4,920	2,320	4,983	295	15,257	13,763	2,166	4,845	20,773	-5,516	-13,771
2044	1,929	3,170	2,320	1,853	295	9,567	13,483	1,863	4,762	20,108	-10,541	-24,312
2045	1,756	2,821	2,320	2,309	295	9,500	13,202	1,645	4,722	19,568	-10,068	-34,380
2046	2,171	3,501	2,320	4,955	295	13,242	13,009	1,546	4,746	19,301	-6,059	-40,439
2047	2,913	4,924	2,320	8,537	295	18,989	12,974	1,551	4,792	19,318	-329	-40,768
2048	6,004	11,770	2,320	15,839	295	36,227	13,466	2,169	5,113	20,748	15,480	-25,288
2049	1,984	3,150	2,320	2,830	295	10,578	13,207	1,694	4,753	19,653	-9,075	-34,362
2050	8,167	15,857	2,320	17,718	295	44,356	13,686	2,411	5,251	21,348	23,007	-11,355
2051	5,645	10,607	2,320	9,945	295	28,812	13,983	2,640	5,118	21,741	7,071	-4,284
2052	3,483	6,525	2,577	5,959	295	18,839	14,103	2,509	4,813	21,425	-2,586	-6,869
2053	2,452	4,787	2,577	6,032	295	16,144	13,898	2,204	4,757	20,859	-4,716	-11,585
2054	9,937	18,129	2,577	12,851	295	43,789	14,794	3,730	5,444	23,968	19,821	8,236
2055	2,131	4,303	2,577	2,189	295	11,495	14,381	2,831	4,754	21,966	-10,470	-2,235
2056	6,766	12,440	2,577	8,314	295	30,393	14,594	3,352	5,099	23,045	7,348	5,113
2057	2,174	4,347	2,577	3,754	295	13,148	14,262	2,560	4,727	21,550	-8,402	-3,289
2058	1,897	4,034	2,577	3,385	295	12,188	13,969	2,213	4,733	20,915	-8,728	-12,016
2059	6,541	12,027	2,577	11,532	295	32,973	14,292	2,695	5,009	21,997	10,976	-1,040
2060	970	2,746	2,577	-705	295	5,883	13,933	2,082	4,690	20,705	-14,823	-15,863

Table 3-15: Projected Upper San Luis Rey Groundwater Subbasin Annual Groundwater Budget (2022 - 2081)

Calendar Year	Areal Recharge from Precipitation	Recharge from Mountain Front Runoff	Return Flow from Applied Water	Streambed Percolation	Recycled Water Spreading	Total Inflow	Groundwater Pumping	Evapotranspiration	Subsurface Outflow	Total Outflow	Change in Groundwater Storage	Cumulative Change in Storage
	acre-ft						acre-ft				acre-ft	
2061	1,697	3,296	2,577	4,074	295	11,939	13,516	1,838	4,661	20,015	-8,076	-23,938
2062	2,366	4,055	2,577	3,326	295	12,620	13,349	1,742	4,737	19,828	-7,209	-31,147
2063	1,133	1,980	2,577	-400	295	5,585	12,971	1,459	4,626	19,056	-13,470	-44,617
2064	3,566	5,909	2,577	10,467	295	22,815	13,027	1,626	4,731	19,385	3,430	-41,187
2065	3,075	4,981	2,577	6,745	295	17,673	12,724	1,423	4,665	18,812	-1,138	-42,325
2066	10,730	19,281	2,577	16,130	295	49,013	14,250	2,449	5,311	22,010	27,003	-15,322
2067	2,571	4,897	2,577	3,829	295	14,169	13,752	1,993	4,757	20,501	-6,333	-21,654
2068	858	1,571	2,577	-2,304	295	2,997	13,314	1,588	4,663	19,565	-16,568	-38,222
2069	2,933	6,195	2,577	7,591	295	19,591	13,154	1,528	4,728	19,410	181	-38,041
2070	3,282	5,335	2,577	8,930	295	20,419	13,251	1,654	4,701	19,606	814	-37,227
2071	5,354	11,055	2,320	14,654	295	33,678	13,457	1,917	4,849	20,223	13,455	-23,772
2072	6,472	12,918	2,320	12,946	295	34,951	13,953	2,528	5,181	21,662	13,289	-10,482
2073	2,739	4,920	2,320	4,982	295	15,256	13,763	2,166	4,845	20,773	-5,517	-15,999
2074	1,929	3,170	2,320	1,852	295	9,567	13,483	1,863	4,762	20,108	-10,541	-26,540
2075	1,756	2,821	2,320	2,310	295	9,501	13,202	1,644	4,722	19,568	-10,067	-36,608
2076	2,171	3,501	2,320	4,956	295	13,243	13,009	1,545	4,746	19,300	-6,057	-42,665
2077	2,913	4,924	2,320	8,538	295	18,989	12,973	1,551	4,792	19,317	-328	-42,993
2078	6,004	11,770	2,320	15,838	295	36,227	13,466	2,169	5,113	20,748	15,479	-27,514
2079	1,984	3,150	2,320	2,830	295	10,578	13,209	1,694	4,753	19,656	-9,077	-36,591
2080	8,167	15,857	2,320	17,718	295	44,356	13,686	2,411	5,251	21,348	23,008	-13,583
2081	5,645	10,607	2,320	9,946	295	28,813	13,983	2,640	5,118	21,741	7,072	-6,512
Average 2022 to 2081	**3,790**	**7,051**	**2,483**	**6,914**	**295**	**20,532**	**13,659**	**2,123**	**4,858**	**20,641**	**-109**	

4.0 Sustainable Management Criteria (§354.22)

Sustainable groundwater management is defined as the *"…management and use of groundwater in a manner that can be maintained during the planning and implementation horizon without causing undesirable results…"* (Water Code Section 10721 (v)). SGMA has identified six sustainability indicators which refer to effects caused by groundwater conditions occurring throughout a basin that, when significant and unreasonable, cause undesirable results (Water Code Section 10721(x)). These are:

- Reduction of Groundwater in Storage
- Chronic Lowering of Groundwater Levels
- Seawater Intrusion
- Degraded Water Quality
- Land Subsidence (not considered applicable in the USLR Valley Groundwater Subbasin)
- Depletion of Interconnected Surface Water (not considered applicable in the USLR Valley Groundwater Subbasin)

Basin sustainability, and the effectiveness of the proposed management actions and programs (Section 6.0) will be judged by the ability to eliminate or avoid undesirable results and conditions represented by the six sustainability indicators, as specifically applicable to the USLR Groundwater Subbasin. For these sustainability indicators, a GSP must develop quantitative sustainability criteria that allow a GSA to define, measure, and track sustainable management. These criteria include the following:

- Undesirable Result (UR) – significant and unreasonable conditions for any of the six sustainability indicators.
- Minimum Threshold (MT) – numeric value used to define undesirable results for each sustainability indicator.
- Measurable Objective (MO) – specific, quantifiable goal to track the performance of sustainable management.
- Interim Milestone (IM) – target value representing measurable groundwater conditions, in increments of five years, set by the GSA as part of the GSP.

The development of these sustainable management criteria relies upon information about the USLR Subbasin developed in the hydrogeologic conceptual model presented in Section 3.0, the description of current and historical groundwater conditions, and the water budget. As discussed in Section 3.0, the USLR is generally operating sustainably under current water demand and water supply conditions. With the exception of several small areas, water quality in the basin is very good and there has been no reported subsidence. The sustainable management criteria are used to establish thresholds and objectives to ensure the USLR Subbasin does not experience undesirable results in the future.

4.1.1 Representative Monitoring Sites

The sustainability criteria form the framework to define sustainable management particular to the basin and delineate between sustainable and unsustainable groundwater conditions based on current and proposed use. In addition, these criteria allow for real-time and consistent tracking of groundwater conditions at representative monitoring sites (RMSs) to show progress towards sustainability, provide early identification of potential problems as they might arise, and allow for timely appropriate decisions to be made regarding additional or modified management actions and projects.

The selected representative monitoring sites are the well set represented by the pumpers that have responded to the call to participate in the GSP. These wells are also part of the preliminary monitoring network, for which historical water level and/or water quality trends are known. Figure 4-1 shows the location of monitoring wells, primarily in the Pauma portion of the USLR with several monitoring wells located in the eastern portion of the Pala Basin. Representative monitoring sites are a subset of the wells in the preliminary monitoring program. These wells were chosen to provide a sufficient distribution throughout the subbasin, have known well construction details, are operational/pumping wells that may be impacted by undesirable results, and have screened intervals representative of alluvial material. Wells were also excluded from representative monitoring sites if there was an issue with historical data and the ability to use it to define sustainability management criteria (e.g., drift in transducer data so that recorded measurements do not represent reality) or the pump setting was below the inferred bedrock surface. The two available monitoring locations in the Pala Portion of the USLR Subbasin (MW-29 and MW-30) did not meet criteria for the selection of representative monitoring sites but will be used to monitor water levels as part of the GSP monitoring program. Table 4-2 summarizes the available well information for the selected monitoring wells.

The current selection of representative monitoring sites (or Key Wells) was used to define undesirable results and other sustainable management criteria for the basin. At the moment, these sites are largely represented by municipal and agricultural supply wells since selection was limited to available information collected or supplied during the GSP development process. It is acknowledged that current sustainability criteria may not be protective of all domestic wells in the basin for which information is largely unavailable. Therefore, additional data will need to be collected following implementation of the GSP to understand where these wells are located, how they operate, and what historical conditions have been in order to determine how beneficial use at these locations can be protected. At the five-year review period, it may be necessary to adjust sustainability management criteria for water levels to accommodate new information about domestic wells and water use to ensure protection of domestic users, including those in the identified SDAC area and in tribal areas. In addition, RMSs to track sustainability management criteria for GDEs and interconnected surface water reaches may be necessary following verification of groundwater dependency and/or interconnectivity.

4.2 Sustainability Goal (§354.24)

DWR states that "*SGMA requires local agencies to develop and implement GSPs that achieve sustainable groundwater management by implementing projects and management actions intended to ensure that the basin is operated within its sustainable yield by avoiding undesirable results*" (DWR, 2016). As discussed in Section 3.3.5, the sustainable yield is a crucial and fundamental element of GSP development, including for the establishment of sustainable management criteria. The importance of the USLR Subbasin sustainable yield is magnified by the fact that groundwater is the sole source of water for some users and provides a significant supply to basin pumpers.

Results of the water balance analysis (from 1991 through 2020) indicate that the sustainable yield for the USLR Subbasin is approximately 12,700 acre-ft/yr. The use of imported water (an average of

2,800 acre-ft/yr since 1991 and generally increasing through time) has led, in part, to the recovery of groundwater levels after the 2012 through 2016 drought.

4.2.1 Description of Sustainability Goal

The sustainability goal for the USLR Subbasin is to manage and preserve its groundwater resource as a sustainable water supply. To the greatest extent possible, the goal is to preserve historic operations of beneficial use in the basin as well as allow for future planned uses as conceived by the GSA and basin stakeholders. The sustainability goal will be accomplished by achieving the following objectives:

- Operate the USLR Subbasin groundwater resource within the sustainable yield.
- Implement projects and management actions to reduce USLR Subbasin groundwater demands, increase efficient use of current supplies, maximize use of supplemental water supplies, and mitigate undesirable results.
- Actively monitor the USLR Subbasin and adaptively manage projects and management actions to ensure the GSP is effective and that undesirable results are avoided.

Sustainable management involves the use and management of groundwater without causing undesirable results, but it does not necessarily include reversing natural undesirable conditions. Moreover, per SGMA §10727.2(b)(4), a GSP may – but is not required – to address undesirable results that occurred before and have not been corrected by the SGMA benchmark date of January 1, 2015. In the USLR Subbasin, no undesirable results are currently present nor have been reported historically. Proposed management actions outlined the GSP (Section 6.0) will further ensure that undesirable results do not occur in the subbasin going forward.

4.2.2 Summary of Sustainable Management Criteria

A summary of the sustainability criteria as relevant to USLR Subbasin and as guided by the Sustainability Goal is provided in the table below (note: since seawater intrusion and subsidence are not likely to occur in the USLR Subbasin, these two indicators were not included). Additional discussion is presented in the following sections for the individual sustainability indicators. The sustainability criteria will provide a means to measure basin management toward sustainable basin conditions. Accordingly, sustainability needs to be achieved either by operating within the current sustainable yield of the groundwater basin or by increasing the sustainable yield through the addition of new water supplies through planned projects.

Table 4-1. Upper San Luis Rey Groundwater Subbasin – Summary of Sustainable Management Criteria

Sustainability Indicator	Undesirable Result	Minimum Threshold	Measurable Objective	Interim Milestone
Groundwater Levels	Groundwater levels at the elevation of current pump settings in representative wells (wells with known construction details and historical water level elevations)	Set at wells by operators as lowest operational level[1]	Elevation representing 3-years of groundwater in storage (approximately 50 ft above MT elevations)[1]	IMs for wells with water levels below the MOs will be determined at 5-year reporting after consistent data collection, refinement of groundwater model, and updated analysis of basin storage to evaluate, if appropriate, the quantity of water needed to reach MO elevations
Groundwater in Storage	Groundwater in storage when water levels are at the elevation of current pump settings	Groundwater in storage at MTs for groundwater levels	3-years of groundwater in storage (approximately 54,000 acre-ft)	To be determined at 5-year reporting period based on refinement of groundwater model and analysis of basin storage from expanded data collection
Interconnected Surface Water/ Groundwater	Groundwater levels fall below the lowest groundwater level since 2015 in identified areas with potentially dependent vegetation	Lowest groundwater level since 2015 in identified areas with potentially dependent vegetation	Maintain seasonal groundwater levels since 2015 in identified areas with potentially dependent vegetation	Based on model-simulated hydrographs, none may be needed. This will need to be confirmed through additional monitoring
Groundwater Quality	TDS and Nitrate above Basin Objectives (800 mg/L for TDS, 45 mg/L for Nitrate as NO_3)	Basin Objectives	TDS and Nitrate as NO_3 at current ambient concentrations (assumed to be the median of available basin wide concentrations: 607 mg/L for TDS, 25.8 mg/L for Nitrate as NO_3)	Current TDS and Nitrate concentrations are at the measurable objectives
Subsidence	Not applicable	Not applicable	Not applicable	Evidence of or potential for land subsidence will be reevaluated in the 5-year report
Seawater Intrusion	Not applicable	Not applicable	Not applicable	The absence of seawater intrusion will be verified in the 5-year report

4.3 Undesirable Results (§354.26)

The approach to assessing sustainability indicators and setting the sustainability criteria has been based on:

1) Review of available information from the Plan Area, Hydrogeologic Conceptual Model, and Historic and Current Groundwater Conditions and Water Budget sections of the GSP, and
2) Discussions with basin stakeholders at GSA meetings and public workshops.

The approach began by qualitatively defining undesirable results based on a simple understanding that an undesirable result is something that cannot be allowed to happen due to potentially unmitigable impact on beneficial use and users. Based on the hydrogeologic conceptual model presented in

Section 3.0, seawater intrusion and subsidence are not likely to occur in the USLR Subbasin. Therefore, these two indicators will be discussed only briefly below.

The monitoring of groundwater levels is directly tied to management of the volume of groundwater storage, so sustainability goals for managing groundwater levels are considered with groundwater storage goals. The monitoring of groundwater levels can also be tied to the streamflow in the San Luis Rey River where groundwater levels are shallow enough to create groundwater/surface water interactions. Currently, there is only one active stream gage along the San Luis Rey River within the USLR Subbasin, and it has a very limited record. The gage (installed by DWR) records river stage height but not discharge volumes. Modifications to this gage and installation of at least one additional gage will be necessary to validate a correlation between surface water and groundwater to assess interconnection between surface flow and groundwater.

Groundwater quality within the subbasin is generally good, with only a few areas with elevated TDS or nitrate. However, the subbasin will be managed, as a whole, to ensure that ambient basin groundwater quality meets the applicable regulations for groundwater quality.

As mentioned previously, the USLR Sustainability Goal has the objective to provide a long-term, reliable, and efficient groundwater supply for agricultural, domestic, municipal, and industrial uses. Undesirable results for the applicable sustainability indicators are discussed in the following sections.

4.3.1 Chronic Lowering of Groundwater Levels (§354.26(a),(b),(c))

Chronic lowering of groundwater levels can indicate significant and unreasonable depletion of supply, causing undesirable results to domestic, agricultural, or municipal groundwater users if continued over the planning and implementation horizon. As a clarification, drought-related groundwater level declines are not considered chronic if groundwater recharge and discharge are managed such that groundwater levels recover during non-drought periods. Declining groundwater levels directly relate to other potential undesirable effects as well (e.g., groundwater storage and interconnected surface water). These effects are described in subsequent sections. Effects on well users are described here.

As stated in Section 3.0, USLR Subbasin groundwater levels fluctuate seasonally due to the availability of rainfall for aquifer recharge. 2020 groundwater elevations raged from 2,700 ft amsl in the uppermost reaches of the groundwater basin to 250 ft amsl at the downstream end of the USLR Subbasin near the Monserate Narrows (see Figure 3-12). Gradients are steep along the flanks of the Valley (approximately 0.07 ft/ft) and much flatter along the axis of the valley (approximately 0.01 ft/ft to 0.008 ft/ft.).

Review of the hydrographs provided on Figures 3-14 and 3-15 indicate that groundwater elevations in Pauma Valley wells have had a generally downward trend from the 1990s, with historically low groundwater elevations during the 2012 to 2016 drought. Groundwater levels have generally increased since 2016 but have not recovered everywhere to pre-drought conditions. Sustainability will be achieved when the seasonal range of groundwater changes remains within a range of elevations that will have no long-term negative impacts on basin pumpers and remain within the sustainable yield through balanced recharge and extractions. Hydrographs in the Pala Valley (Figure 3-15) indicate that groundwater levels have generally been more consistent in the downgradient portions of the USLR Valley Groundwater Subbasin.

Accordingly, the definition of undesirable results would be the chronic lowering of groundwater levels, indicating a significant and unreasonable depletion of supply if continued over the planning and implementation horizon. In particular, undesirable results with respect to groundwater elevations are those elevations that will have a negative impact on basin pumpers, such as groundwater elevations falling below a depth where well pumps become non-operational, or the well can no longer produce the volume of water required to meet the demand of the pumper.

4.3.1.1 Potential Causes of Undesirable Results

Groundwater level has generally declined since the 1990s with periods of recovery beginning in 2004 and 2011. Review of historical groundwater contours indicates that groundwater levels in wells have declined to elevations below the top of well screens of some basin pumpers but, for the most part, have not resulted in the inability to run the wells. At times, the seasonal or annual lowering of groundwater levels in the past has necessitated agricultural users to purchase water for irrigation. Nevertheless, without implementation of sustainability goals to maintain basin operation within sustainable limits (i.e., pumping in excess of sustainable yield), undesirable results could occur in the future.

4.3.1.2 Potential Effects on Beneficial Uses and Users

Groundwater is a significant source of supply in the Plan Area and supplies wells for agricultural, municipal, industrial, and domestic beneficial uses. Groundwater has been and is being used for a range of beneficial uses, even during drought, and with reasonable operation and maintenance by well owners. Undesirable results in regard to groundwater elevations include the lowering of groundwater levels to a depth where the wells cannot be operated. Significant lowering of groundwater levels can require lowering of pumps and increased energy costs from the additional hydraulic lift. However, the USLR Subbasin is a shallow groundwater basin with generally short well screens and pump settings. Maintaining groundwater levels at the appropriate elevations so as to not result in well production reductions of the required supply will eliminate the need to change pump settings in the future.

4.3.2 Reduction of Groundwater in Storage

Groundwater in storage is the volume of groundwater in the basin that is available for groundwater production. In the USLR Subbasin, groundwater in storage is water that is within the pore spaces of alluvial aquifer that lies above the bedrock surface and below the phreatic surface (water table). Undesirable results are defined with respect to the Sustainability Goal for the USLR Subbasin which includes an objective to provide reliable storage for water supply resilience during droughts and shortages. As such, the definition of potential undesirable results for storage reduction would be the inability of the groundwater basin to meet water supply demands during drought periods and includes consideration of how much storage has historically been in the basin (i.e., operating storage) and how much stored groundwater reserve is needed to withstand drought. To date, the basin has not reached a point considered to be reflective of undesirable results. While groundwater levels in some basin wells have fallen below the top of screen elevations, basin pumpers have reported that the wells have continued to operate and supply the requisite volume of water to maintain operations.

The USLR is a shallow groundwater basin with limited storage. Therefore, additional deeper storage is not available to sustain pumping during drought periods. Based on historical and current pumping and groundwater trends, managing groundwater levels in the future above the MTs will result in an appropriate amount of groundwater in reserve. If future operations from any of the basin pumpers include increasing pumping volumes or new extractions are planned, the current analysis will require revisiting and additional supplies or reductions elsewhere may be required. Basin management should include recommendations to reduce groundwater production during drought years in order to aid the maintenance of groundwater levels above MTs.

4.3.2.1 Potential Causes of Undesirable Results

As with a chronic lowering of groundwater levels, undesirable results with respect the groundwater in storage can be the result of sustained groundwater extraction in excess of the long-term sustainable yield. In addition, a portion of applied water (contributing to groundwater return flow) currently comes from the direct delivery of imported water. The return flow from this applied, imported surface water contributes to the water budget and meets a portion of the water demand in the basin. If the imported water supply is reduced or disrupted, continued pumping could further reduce groundwater in storage. The planned reserves discussed above do not consider the use of imported water or other sources of groundwater recharge during a three-year drought.

4.3.2.2 Potential Effects on Beneficial Uses and Users

Groundwater is a significant source of supply for basin pumpers, primarily for agriculture. Reduction of groundwater in storage would reduce access to supply with adverse effects on the community, economy, and environmental setting of portions of the USLR which are reliant on groundwater. Groundwater has historically been available during droughts.

4.3.3 Degradation of Water Quality

Degraded water quality can impair water supply and affect human health and the environment. Impacts to drinking water supply wells can result in increased sampling and monitoring, increased treatment cost, use of bottled water, negative impacts on agriculture, and the loss of wells. An overview of groundwater quality in the USLR Subbasin is provided in Section 3.3.4.3. Current ambient for total dissolved solids (TDS) and nitrate (as NO_3) – two important indicators of groundwater quality – in Pauma Subbasin is approximately 607 mg/L and 25.8 mg/L, respectively. Figures 3-17 and 3-18 show historical and current water quality measurements for TDS while Figures 3-19 and 3-20 show historical and current water quality measurements for Nitrate (as N). There were insufficient data to characterize ambient groundwater quality in Pala Subbasin.

Undesirable Results are defined in the GSP Regulations (§354.26) as occurring when significant and unreasonable effects for any of the sustainability indicators are caused by groundwater conditions occurring throughout the basin. The GSA is not responsible for local problems or degradation caused by others. At present, there are no sites under regulatory clean-up within the basin. Undesirable results then are defined as the degradation of groundwater from current ambient conditions, taken to the be the median concentration of average water quality in wells with at least three water quality readings from 2015 through 2020 (see Section 3.3.4.3). The sustainability goal of maintaining water quality applies to specific well locations as well but tracking trends in ambient basin water quality will allow for an evaluation of general water quality throughout the USLR Subbasin.

Given the restricted amount of water quality data available in the subbasin (both spatially and temporally), additional data collection efforts and analyses are required to better understand and characterize water quality. Through the incorporation of additional RMSs, as needed, to better protect domestic and tribal users, as well as the establishment of monitoring locations in data gap areas, undesirable effects as they pertain to water quality can be better evaluated to help manage resources for all basin users.

4.3.3.1 Potential Causes of Undesirable Results

There is a tendency in groundwater basins towards the general degradation of groundwater quality through time due to irrigation and septic return flows, use of imported water, and evapotranspiration. Therefore, maximizing recharge from natural precipitation may provide the best means of mitigating undesirable results from routine beneficial use.

4.3.3.2 Potential Effects on Beneficial Uses and Users

Further degradation of groundwater quality with respect to TDS and nitrate could cause loss of beneficial use to basin users with regard to landscape and agricultural irrigation due to salinity requirements, expensive treatment of water for municipal and domestic use, and potential increased costs for the few treatment plants that are located within the subbasin.

4.3.4 Depletions in Interconnected Surface Water

The major stream in the USLR Subbasin is the San Luis Rey River. The San Luis Rey River extends from Lake Henshaw to the Pacific Ocean at Oceanside Harbor. However, as described in Section 3.3.3.1.3, the majority of flow released from Henshaw Dam are diverted into the Escondido Canal, where it is exported for use in Vista Irrigation District (VID) and City of Escondido service areas. Only water unable to be captured by the diversion structure (typically during peak storm flow) and natural flow from rainfall and stormflow downstream of the diversion structure are available to maintain surface flow in the San Luis Rey River. However, very few measurements of surface flow are available in Pauma and Pala Valleys. Therefore, current understanding of surface water and groundwater interactions in the USLR Subbasin are informed by reported observations, groundwater levels (where data are available), and model-calculated streamflow and groundwater elevations using the USLRGM (what limited gaged measurements of surface flow were available were used to calibrate the surface water model component).

Since surface water is not a significant source of water supply in the USLR Subbasin, undesirable effects from depletions in interconnected surface water primarily relate to potentially groundwater dependent ecosystems (GDEs). Areas of potentially dependent vegetation were identified in Section 3.3.4.5 through a review of historical imagery and available mapping. During the process of developing sustainability goals for depletions in interconnected surface water, the calibrated USLRGM (see Section 3.3.5.1) was used to delineate the areas of potentially groundwater dependent vegetation to those locations throughout the basin where simulated groundwater levels since 2015 were less than 20 to 30 ft bgs. This depth is considered to be the typical extinction depth for most deep-rooted riparian vegetation; most roots of riparian vegetation would not be able to access groundwater resources if groundwater levels were deeper than this threshold. These areas are shown on Figure 3-25. Groundwater dependency of areas outlined as potential GDEs must first be verified through field investigation and additional data collection. RMSs and sustainability management criteria will then be refined as necessary to avoid significant and unreasonable effects to GDEs.

4.3.5 Land Subsidence

Land subsidence is not of concern for the USLR Groundwater Subbasin due to a lack of significant thickness of compressible fine-grained sediments and the overall shallow character of the alluvial basin, as discussed in Section 3.3.4.7. Therefore, land subsidence as a sustainability indicator is not applicable to the USLR Groundwater Subbasin and no sustainability management criteria were developed. However, the GSA has determined that any land subsidence caused by the lowering of groundwater levels in the subbasin would be considered significant and unreasonable. Evidence of or potential for land subsidence will be reevaluated in the five-year report.

4.3.6 Seawater Intrusion

Given the distance of the downgradient boundary from the ocean, seawater intrusion is not of concern for the USLR Groundwater Subbasin. In addition, while seawater intrusion has historically occurred in the downgradient Lower San Luis Rey Groundwater Subbasin, minimum threshold groundwater elevations designed to maintain a seaward groundwater gradient are currently being implemented in the Mission Subbasin to protect inland areas from further seawater intrusion (see Section 2.4.1). Therefore, seawater intrusion as a sustainability indicator is not applicable to the USLR Groundwater Subbasin and no sustainability management criteria were developed. The absence of seawater intrusion will be verified in the five-year report.

4.4 Minimum Thresholds (§354.28)

4.4.1 Chronic Lowering of Groundwater Levels

According to GSP Regulations Section 354.28(c), the MT for chronic lowering of groundwater levels must be the groundwater elevation indicating depletion of supply at a given location that may lead to undesirable results. MTs for chronic lowering of groundwater levels are to be supported by information on the rate of groundwater elevation decline based on historical trends, water year type, and projected water use in the basin. In the USLR Subbasin, the MT relative to the chronic lowering of groundwater levels is defined at designated Key Wells by historical groundwater water levels and the elevation of the top of the well screens for the known basin pumpers.

The general approach to defining sustainability criteria (MTs and MOs) for groundwater levels has involved the development of a groundwater elevation surface constructed from monitoring well sites in the basin. As mentioned in Section 4.1.1, the representative monitoring sites for evaluating sustainability criteria related to groundwater levels include a collection of wells including municipal, private, and agricultural pumpers. Well information was limited to that provided during the stakeholder data request period.

Groundwater surface elevations were selected by individual basin pumpers who have elected to participate in the GSP process. The pumpers who are participating in the GSP process represents groundwater extractions almost exclusively in the Pauma Valley portion of the USLR Groundwater Subbasin. Pumpers provided the minimum depth for each of their wells to operate successfully based on their past experiences during drought conditions. This approach is founded on the idea that undesirable results – whether reported or not – should not be allowed to occur in the future. Therefore, MTs and MOs at reported active wells were developed to avoid reaching the point of an undesirable result in the individual wells. Groundwater levels falling below the selected MTs represent an undesirable result at the specific well location. Due to the lack of well information and low resolution of groundwater elevation conditions in general (except around wells with observed measurements – primarily in Pauma Subbasin), a spatial analysis of MTs and water level impacts on all basin wells and groundwater users in the subbasin was not possible. Review and modification of MTs, or the addition of supplemental representative monitoring sites in different areas of the subbasin, may be required in future 5-year updates to ensure beneficial use for all groundwater pumpers, including domestic, SDAC, and tribal users. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in 25 percent or more of the Key Wells.

MTs for the representative monitoring sites are summarized in Table 4-3. These correspond to the minimum operational groundwater levels provided by participating basin pumpers. The MTs are lower than historical lowest groundwater levels and are based upon the minimum level that would continue to allow production from each well. The MT elevations are shown in relationship to historical groundwater levels and known well screen intervals for each well on Figures 4-2 and 4-3. In all cases, the MT elevation is at least five feet above the current pump settings in each of the wells.

4.4.2 Reduction of Groundwater in Storage

SGMA guidance documents do not recommend a specific requirement for groundwater in storage. Considerations offered by the “Draft Best Management Practices for Sustainable Management of Groundwater - Sustainable Management Criteria BMP” when establishing the MT for groundwater storage may include, but are not limited to:

- What are the historical trends, water year types, and projected water use in the basin?
- What groundwater reserves are needed to withstand future droughts?
- Have production wells ever gone dry?
- What is the effective storage of the basin? This may include understanding of the:
  - Average, minimum, and maximum depth of municipal, agricultural, and domestic wells.
  - Impacts on pumping costs (i.e., energy cost to lift water).
- What are the adjacent basin’s minimum thresholds?

Undesirable results would involve insufficient stored water to sustain beneficial uses through drought periods. The storage criterion is directly linked to groundwater levels and is evaluated as a volume on a basin-wide basis. Therefore, the MT for groundwater storage is fulfilled by using the MT for groundwater levels as a proxy.

The general approach for defining sustainability criteria for groundwater in storage has involved review of historical cumulative change in storage and expected future storage declines during droughts. Review of historical change in storage indicates that an average decline in groundwater storage of 1,520 acre-ft/yr has occurred between 1991 and 2020. During the 2012 through 2016 period (representing the most recent drought period), declines in groundwater storage averaged 6,310 acre-ft/yr. Historically, groundwater has been available even when groundwater levels reached historical low elevations. Management of groundwater levels above the MTs will result in sufficient groundwater in storage to meet historical demands. Reduction of pumping or addition of supplies to balance the water budget will further ensure a reliable water supply for basin pumpers.

4.4.3 Degradation of Water Quality

For the decision to set sustainable management criteria for water quality, SGMA poses two basic questions:

- Were undesirable results occurring as of the SGMA baseline of January 2015? and
- Is there a potential for future undesirable results?

Regarding the first question, TDS and nitrate exceed objective levels in several areas of the Subbasin (see Figures 3-18 and 3-20), even though overall ambient water quality is below basin objectives. Regarding the second question, continued agricultural practices and use of imported water and septic systems in the subbasin may lead to gradual water quality degradation without sufficient amounts of natural recharge to dilute loading from these sources.

As stated in Section 3.3.4.3, basin water quality objectives for TDS and Nitrate as NO_3 in Pauma Subbasin are 800 mg/L and 45.0 mg/L, respectively. The sustainability goal—to protect groundwater quality—is to prevent degradation of water quality by maintaining ambient groundwater quality below basin objectives and maintaining or reducing the percentage of wells with median concentrations exceeding basin objectives. MTs for the degradation of water quality represent basin water quality objectives which also meet state and federal maximum contaminant levels (MCLs) for drinking water.

4.4.4 Depletions in Interconnected Surface Water

Undesirable results and MTs for depletions in interconnected surface water would be groundwater levels falling below the lowest groundwater level since 2015 in the identified areas with potentially dependent vegetation (Figure 3-25).

4.5 Measurable Objectives (§354.30)

4.5.1 Chronic Lowering of Groundwater Levels

MOs for the chronic lowering of groundwater levels are defined as an operating range of groundwater levels allowing reasonable fluctuation with changing hydrologic conditions. The MTs represent the bottom of the operating range and are protective of basin pumpers while the MOs for groundwater levels are also subject to the need of each basin pumper. The MO for the USLR Subbasin is set at a groundwater elevation that coincides with three years of operational storage for the basin. The calibrated USLR Groundwater Model (USLRGM) was used to calculate these elevations at the identified Key Wells, which are summarized in Table 4-3. In general, this corresponds to approximately 50 ft of groundwater elevation over MTs.

Groundwater levels in 2020 approximately represent a three-year volume of storage where a minimum of 18,000 acre-ft/year is required to meet the water demands of the basin. Three years of groundwater storage is equivalent to 54,000 acre-ft. This value is conservative because it allows three years of groundwater reserves to meet water demand, even though much of that demand is currently satisfied through imported water. Therefore, this approach for defining MOs against the lowering of groundwater levels (as well as groundwater storage) also allows protection against periods of prolonged drought or below average precipitation years. Average annual groundwater pumping from 1991 through 2020, as noted in Section 3.0, is approximately 14,000 acre-ft/yr. Imported water use for the last nine years (Water Year 2012 through 2020) was approximately 4,000 acre-ft/yr. Even more recently (Water Year 2018 through 2020), imported water use has been closer to 5,200 acre-ft/yr (Figure 3-31).

At approximately half of the representative monitoring sites, current (June 2021) groundwater levels are below MOs. These wells are generally located near the center of the Pauma Subbasin where there appears to be a greater pumping depression in the basin. Based on projected water budgets assuming a continuation of water use conditions in the Subbasin, the long-term change in storage is approximately -100 acre-ft/yr. However, in any individual dry year or sequence of wet years, the change in storage can be two orders of magnitude higher or lower.

4.5.2 Reduction of Groundwater in Storage

Since the sustainability indicator for groundwater in storage addresses the ability of the groundwater basin to support existing and planned beneficial uses of groundwater, recent drought conditions were considered when establishing sustainability management criteria for groundwater levels and groundwater storage. Figure 3-2 shows the rainfall record from 1943 through 2020 at Lake Henshaw. The chart includes a cumulative departure line which indicates generally hydrologic conditions: a downward trend represents dry conditions while and upward trend represents wet conditions. The average rainfall for the historical water budget base period (1991-2020) is slightly higher than the long-term average rainfall. However, during the most recent extended drought (2012-2016) pumping has continued in the groundwater basin. Pauma hydrographs with records during the most recent drought (see Figure 3-14) show a steady decline. However, with increased rainfall of Water Years 2018 and 2019, basin water levels show recovery (albeit not necessarily to the pre-five-year drought levels). A portion of the groundwater level recovery is also attributed to availability of imported water to augment groundwater pumping. Groundwater level data for the Pala Subbasin within the USLR is very limited. Two wells (WG-1/09S01W31L located at the upstream portion or Pala Subbasin and 10S2W6F2 located in the downstream portion of Pala Subbasin) have water level records spanning the 2012-2016 drought (see Figure 3-15). The data show that groundwater levels remained essentially stable, suggesting that pumping in the Pauma Subbasin was less than the decrease in inflow to this portion of the subbasin during the drought.

Planning for Urban Water Management Plans requires an assessment of available water supplies for a normal, single dry, and five-year drought period. For planning purposes, as selected by basin stakeholders, considered herein is a groundwater reserve for a three-year dry period. The approach taken was to determine the groundwater elevation which represents a three-year supply (approximately 54,000 acre-ft) above the elevation of the MTs at selected wells (see Table 4-3). The MO for storage is also fulfilled by the MO for groundwater levels, which maintains groundwater levels within the operating range to protect operations of municipal, agricultural, and domestic wells in the basin and provide for a minimum three-year supply of groundwater.

The MO elevation for groundwater levels was set at an elevation which conservatively represents the volume of a 3-year reserve between the MO elevation and the MT elevation. The 3-year reserve volume does not consider annual inflow to the basin that will occur even during drought periods or availability of imported water, so it is very conservative. Since sustainable management criteria for groundwater levels are being used as a proxy for groundwater storage, the interim milestones would be those discussed above.

4.5.3 Degradation of Water Quality

MOs for the degradation of water quality are to maintain water quality at current ambient conditions. In particular, maintaining TDS and Nitrate as NO_3 at current ambient concentrations (607 mg/L and 25.8 mg/L, respectively). Ambient water quality in the Pauma Subbasin is currently below basin objectives. Water quality at individual wells will be evaluated on an annual basis and the ambient water quality will be recalculated to ensure that MOs are maintained across the groundwater basin.

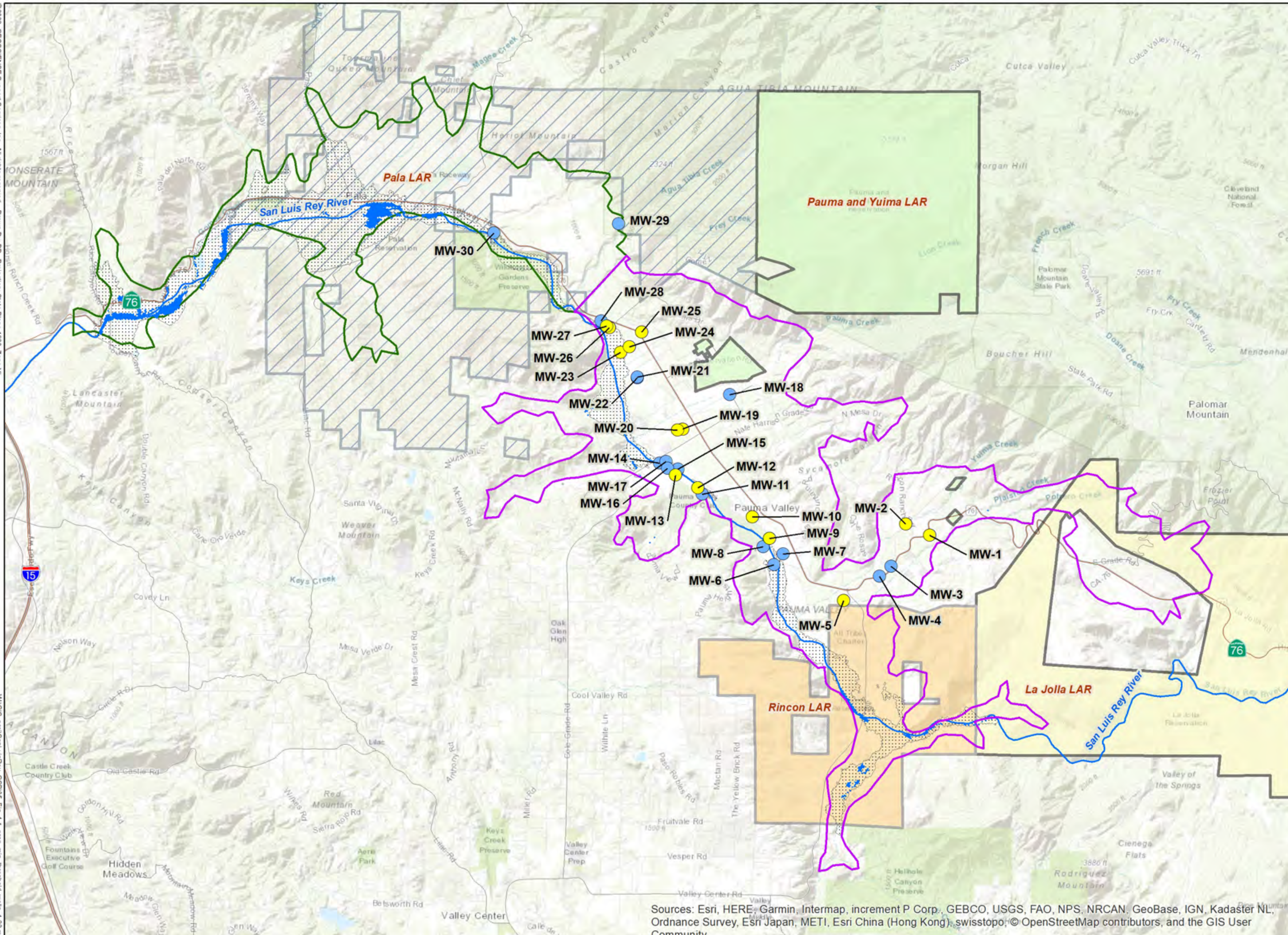
4.5.4 Depletions in Interconnected Surface Water

Due to the lack of measured observations for surface water flow and groundwater levels near areas of potentially groundwater dependent vegetation, an initial evaluation was made using the calibrated surface water and groundwater model for the USLR. Model-calculated groundwater levels in these identified areas indicate that groundwater levels are within three feet, at, or above ground surface. MOs for the depletion of interconnected surface water would be to maintain seasonal groundwater levels since 2015 in the identified areas with potentially dependent vegetation. Since the current evaluation is limited to model-simulated surface flows and groundwater levels in the areas identified as having vegetation that may be dependent on groundwater, site-specific monitoring of groundwater levels and surface flow gages will be needed to confirm groundwater / surface water interactions. Sustainability management criteria may require refinement following collection of field data.

4.6 References (§354.4(b))

DWR (California Department of Water Resources), 2018. Sustainable Groundwater Management Program Resource Guide: DWR-Provided Climate Change Data and Guidance for Use During Groundwater Sustainability Plan Development. Dated July 2018.

DWR, 2017. Best Management Practices for the Sustainable Management of Groundwater: Sustainable Management Criteria. Dated November 2017.



REPRESENTATIVE MONITORING SITES FOR EVALUATING SUSTAINABLE MANAGEMENT CRITERIA

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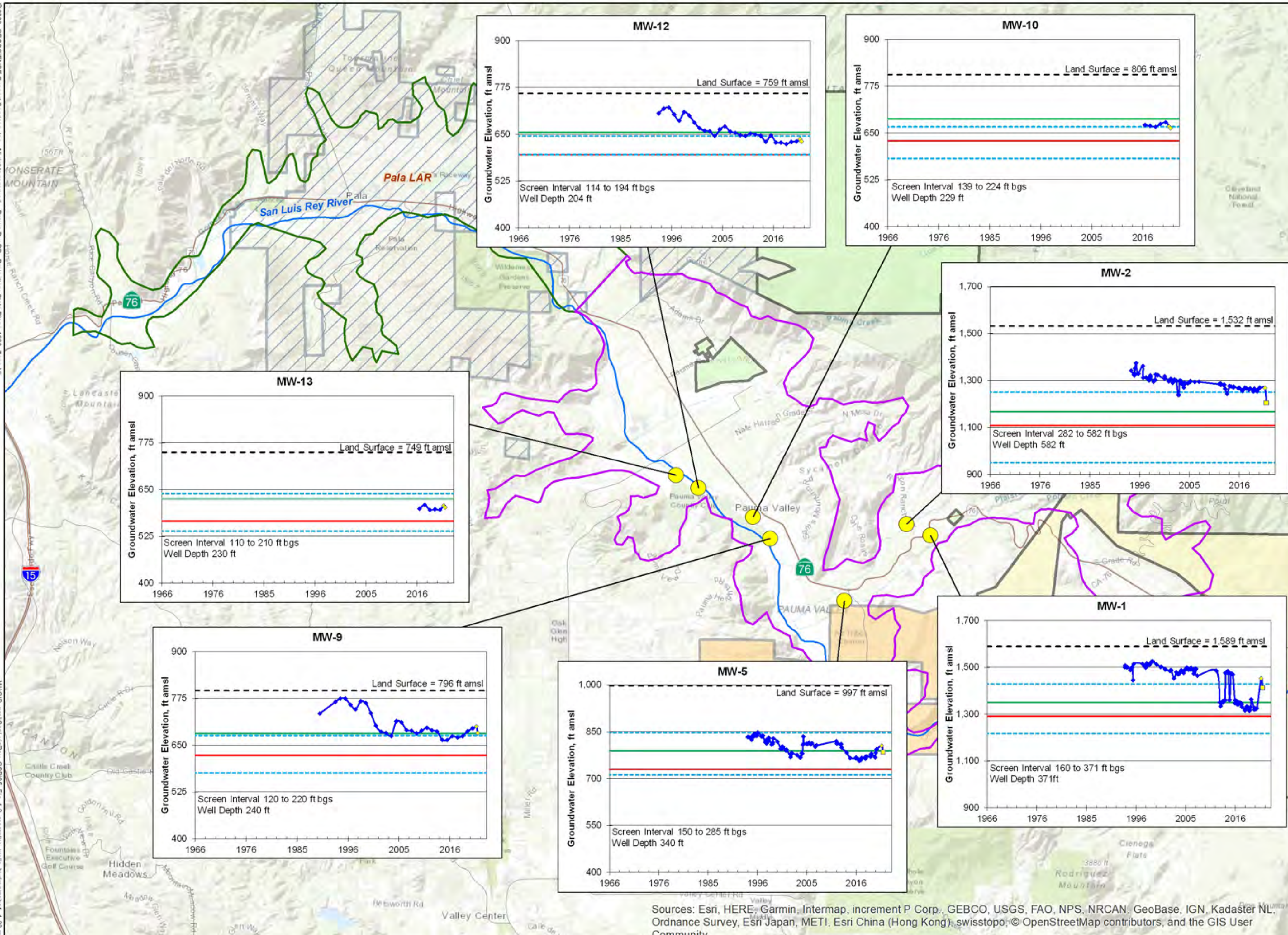
Jan-22

FIGURE 4-1



EXPLANATION

- Representative Monitoring Site with Minimum Threshold (MT) and Measurable Objective (MO) for Groundwater Elevation
  See Tables 4-2 and 4-3
- Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)
- Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)

Land Area Representation (BIA, 2020)

- La Jolla LAR
- Pala LAR
- Pauma and Yuima LAR
- Rincon LAR
- Minimum Threshold
- Measurable Objective
- Screen (top and bottom)
- Land Surface
- Measured During Static Periods
- Measured During Pumping Periods
- Geoscience Measured During Static Periods
- Geoscience Measured During Pumping Periods

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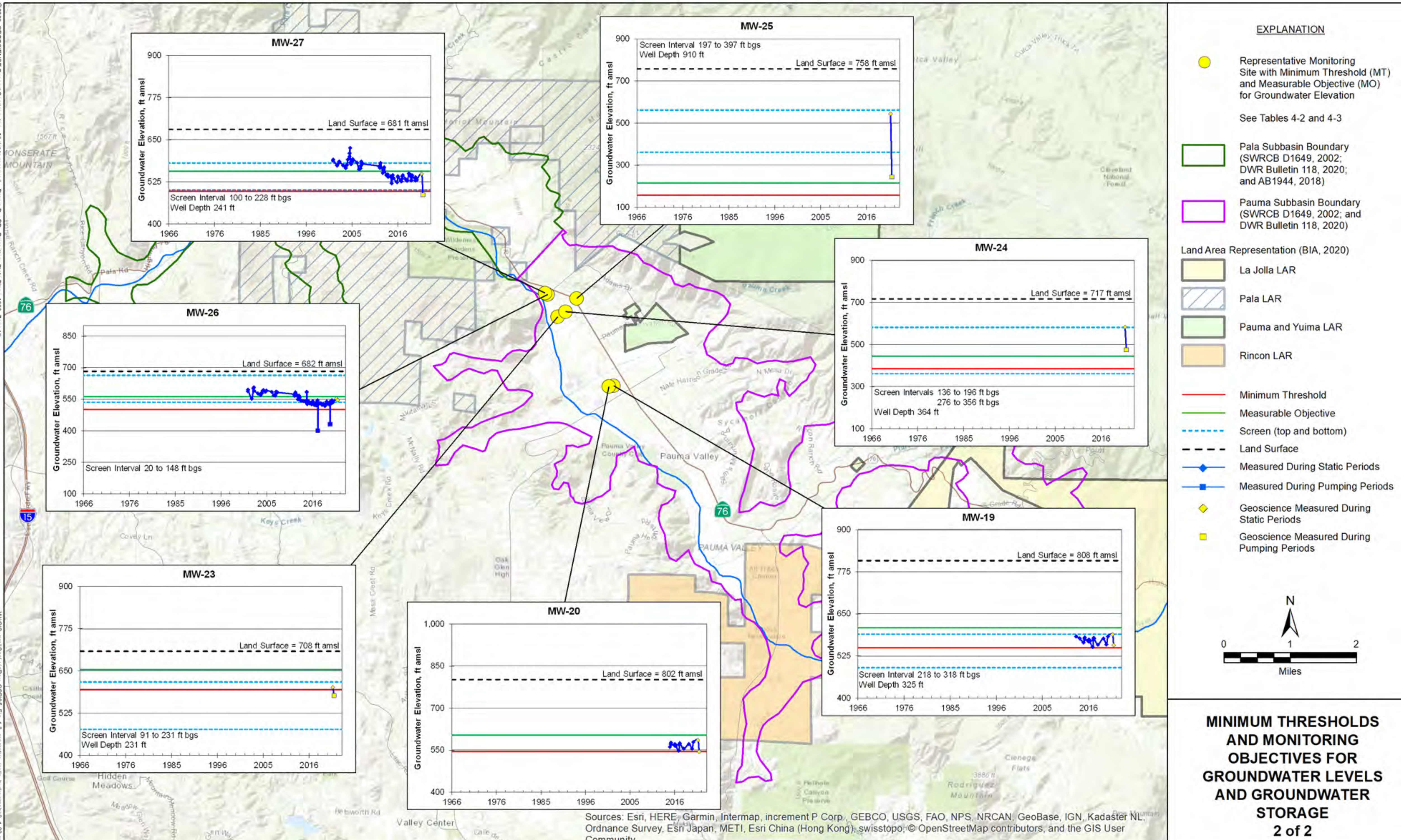
MINIMUM THRESHOLDS AND MONITORING OBJECTIVES FOR GROUNDWATER LEVELS AND GROUNDWATER STORAGE
1 of 2

Jan-22

FIGURE 4-2

GEOSCIENCE



MINIMUM THRESHOLDS AND MONITORING OBJECTIVES FOR GROUNDWATER LEVELS AND GROUNDWATER STORAGE 2 of 2

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Well Information for Preliminary Monitoring Network Wells and Representative Monitoring Sites

ID	Land Surface Elevation [ft amsl]	Reference Point (RP) Stick Up [ft]	Screen Interval [ft bgs]	Screen Top [ft bgs]	Screen Bottom [ft bgs]	Pump Setting Depth [ft bgs]	Notes
MW-1	1,588.91	2	160-371	160	371	320	
MW-2	1,531.64	1.81	282-582	282	582	440	
MW-3	1,276.59	1.61	TD = 368			320	Not Operational
MW-4	1,199.12	0.54	75-124, 128-284, 284-405?, all perf.	75	405	300	Not Operational
MW-5	997.61	2.63	150-285	150	285	285	
MW-6	802.56	2.8	120-200, 150-450	150	450	200	
MW-7	800.40	1.5	115-255	115	255	250	
MW-8	797.25	2.45	116-214	116	214	198	
MW-9	796.52	1.72	120-220	120	220	190	
MW-10	805.98	2.68	139-224	139	224	195	
MW-11	765.32	?	100-200	100	200	337	
MW-12	759.12	1.53	114-194	114	194	180	
MW-13	748.84	1.83	110-210	110	210	200	
MW-14	743.90	0.927	110-200	110	200	180	
MW-15	754.26	2.43				No Pump	Not Operational
MW-16	746.61	1.98				No Pump	Not Operational
MW-17	745.86	1.45				No Pump	Not Operational
MW-18	952.39	3.61	TD = 1,812			815	Bedrock
MW-19	808.37	3.1	218-318	218	318	310	
MW-20	802.25	1.93				295	
MW-21	738.11	2.93	576-1,075	576	1,075	800	Bedrock
MW-22	738.20	3.14				275	
MW-23	708.32	2.25				210	
MW-24	716.73	2.93	136-196, 276-356	136	356	340	
MW-25	757.70	3.07	197-397	197	397	609	
MW-26	682.53	4.65				200	
MW-27	681.03	1.34	100-180	100	180	200	
MW-28	748.82	1.1				No Pump	Not Operational
MW-29	1,247.15	1.83	TD = 220			200	Bedrock
MW-30	499.34	1.71	TD = 140			120	

Note: Highlighted wells were chosen to be represenative monitoring sites for the evaluation of sustainable management criteria

Table 4-3

Sustainable Management Criteria for Representative Monitoring Sites

Well ID	March 2021 [ft below RP]	June 2021 Depth to Water [ft below RP]	June 2021 Groundwater Elevation [ft amsl]	Minimum Threshold Elevation [ft amsl]	Depth to Water at Minimum Threshold Elevation [ft bgs]	Measurable Objective Elevation (Threshold for 54,000 Acre-ft Operational Storage) [ft amsl]	Depth to Water at Measurable Objective [ft bgs]
MW-1	138.51	178.45	1,412.46	1,291	300	1,350	241
MW-2	265.52	328.21	1,205.24	1,108	425	1,168	366
MW-3	262.17	291.97	986.23	NA	NA	NA	NA
MW-4	207.25	212.10	987.56	NA	NA	NA	NA
MW-5	195.05	215.88	784.36	730	270	789	211
MW-6*	74.65	170.00	635.36	NA	NA	NA	NA
MW-7*	80.19	105.10	696.80	NA	NA	NA	NA
MW-8*	95.52	118.35	681.35	NA	NA	NA	NA
MW-9	98.20	115.88	682.36	623	175	682	116
MW-10	141.48	145.18	663.48	629	180	688	121
MW-11	158.88	164.48	603.02	NA	NA	NA	NA
MW-12	123.73	130.00	630.65	596	165	655	106
MW-13	143.85	148.13	602.54	566	185	625	126
MW-14	151.40	154.10	590.72	595	150	654	91
MW-15	47.90	48.27	708.42	NA	NA	NA	NA
MW-16	41.46	42.70	705.89	NA	NA	NA	NA
MW-17	40.46	41.43	705.88	NA	NA	NA	NA
MW-18	319.55	316.77	639.23	NA	NA	NA	NA
MW-19	222.20	255.01	556.46	549	262	609	203
MW-20	218.51	258.82	545.36	545	259	604	200
MW-21	216.58	488.10	252.94	NA	NA	NA	NA
MW-22	100.20	120.12	621.22	NA	NA	NA	NA
MW-23	109.13	133.54	577.03	506	205	565	146
MW-24	137.35	244.65	475.01	385	335	444	276
MW-25	217.10	516.91	243.86	157	604	216	545
MW-26	134.60	142.70	544.48	502	185	561	126
MW-27	133.55	196.09	486.28	497	185	557	126
MW-28	114.17	114.85	635.07	NA	NA	NA	NA
MW-29	124.69	117.55	1,131.43	NA	NA	NA	NA
MW-30*	45.19	94.98	406.07	NA	NA	NA	NA

Orange cells respresent wells with current water levels below Measurable Objectives
*These wells were removed due to the pump elevation being below bedrock

5.0 Monitoring Network (§354.32; §354.34)

Groundwater monitoring is key to SGMA compliance as it provides the basis to evaluate groundwater level trends for sustainability and can be used to demonstrate measured progress toward achieving sustainability goals through implementation of the GSP. During development of the GSP, available well information was reviewed to identify wells in the groundwater basin that would provide a good foundation for characterizing current groundwater conditions and which could be used for future, on-going monitoring after GSP implementation. 30 existing wells were identified that were available for the monitoring and sampling conducted in 2021 for the GSP (Figure 5-1). These include pumping wells owned and operated by various water agencies and private agricultural operations. At present, no de minimis users have come forward in response to requests for well information or following discussion at GSP workshops. Using existing wells reduces GSP implementation costs by minimizing costs associated with drilling new monitoring wells. In addition, many of the wells used in the GSP monitoring well network have the benefit of previous groundwater level measurements and water quality results, providing a record of previous hydrologic conditions that is used to evaluate trends.

During the development of the GSP, quarterly groundwater level measurements were obtained from the monitoring network. In addition, 15 or the wells were sampled semi-annually (in March and October 2021) to provide a representation of ambient groundwater conditions in the basin. The wells used for sampling are depicted on Figure 5-2. Monitoring events were conducted by Geoscience and team member SCS Engineers (SCS), and the semi-annual sampling was conducted by SCS Engineers. This section summarizes the proposed monitoring network for on-going monitoring in support of GSP implementation.

5.1 Monitoring Network Objectives (§354.34(b))

The monitoring network for the USLR Valley GSP was designed to provide sufficient data from the basin to establish ambient conditions for basin characterization and demonstrate short-term, seasonal, and long-term trends in groundwater and related surface water conditions, including annual changes in water budget components. After implementation of the GSP, the monitoring network will also provide representative data to evaluate GSP sustainability indicators and objectives, including groundwater levels, groundwater storage, water quality, and depletions in interconnected surface water, in accordance with the specific sustainability goals established by the GSA. Recommendations for additional monitoring locations and considerations are provided in Section 5.5. A periodic re-evaluation of the representative monitoring sites (RMSs; see Section 4.1.1) will be conducted as data are collected and analyzed.

The monitoring network and monitoring plan is designed to evaluate groundwater and surface water conditions in the basin to demonstrate progress toward achieving the measurable objectives described in the GSP. With on-going collection of groundwater level and quality data, impacts to beneficial uses of groundwater will be continually evaluated. If impacts are occurring, one or more of the proposed projects and management actions outlined in Section 6.0 may be implemented to mitigate impacts, protect beneficial uses, and avoid undesirable results.

The monitoring network functions to allow collection of data relative to groundwater levels, and groundwater flow direction and gradient. From this data, an evaluation can be made of changes in groundwater conditions such as storage (groundwater depths), and water quality. These data are used to quantify changes in the water budget components, and to evaluate sustainability indicators. Data may also be used to update the groundwater flow model of the subbasin to refine estimates of sustainable yield and improve the model's reliability for evaluating future projects and management actions.

5.2 Monitoring Locations (§354.34(h))

The wells monitored during the GSP development process are shown on Figure 5-1 for water level and Figure 5-2 for water quality. Well information is summarized in attached Table 5-4. These wells were selected based on available data, geographic and vertical distribution, and willingness of owner to participate in GSP monitoring effort. Where good well coverage was available, selected monitoring locations were determined based primarily on available data (wells with greater historical data coverage were prioritized over wells with less or no available information) in order to take advantage of the historical data record. To maintain confidentiality of the well locations and well owners, wells selected for GSP monitoring have been given a unique ID.

5.3 Data Gaps (§354.38(a),(b),(c))

Data availability in the USLR Valley Groundwater Subbasin is limited, both spatially and temporally. Spatially, the majority of data available for evaluation of hydrologic conditions were located in major pumping areas of the Pauma Subbasin, such as the valley area along the San Luis Rey River and between Potrero and Yuima Creeks. Insufficient data control in Pala Subbasin and the alluvial fan areas of Pauma makes it difficult to reliably interpret conditions away from the center of the Pauma Subbasin. Well information associated with what limited data there are is also often unavailable, such as well depth and screening information, which makes it difficult to accurately characterize conditions. This is especially true when two nearby data points are inconsistent with each other and not enough is known about either to determine what factors may be leading to these differences. Other available data sets contained questionable or inaccurate data (such as visible transducer drift) and were unable to be used. Temporally, data frequency is often sporadic or limited to annual measurements, making it impossible to assess seasonal characteristics and trends. Given these significant data gaps, the GSP has identified the importance of additional data collection as a Tier 1 management action going forward (see Section 6.2.2). Addressing data gaps will allow the PVGSA to more accurately and completely understand basin conditions (as they relate to groundwater levels and storage, water quality, and groundwater/surface water interactions), refine estimates of sustainable yield to improve basin management, and track progress towards maintaining sustainability and meeting management objectives. Specific data gaps as they pertain to general basin characterization and monitoring efforts during the GSP development and implementation phases are discussed in the following sections.

5.3.1 Well Location and Information

Identification of wells in the area involved use of several state and county databases (including DWR Bulletin 91-18, DWR well logs, CASGEM, GAMA, USGS NWIS, DDW, and San Diego County Department of Environmental Health records), submitted information obtained from data request efforts during the development of the GSP, air photo interpretation, and information included in previous investigations and reports. However, many of the information in public databases are incomplete or inaccurate. Well locations in particular typically have a high degree of uncertainty associated with them and many are located in the centroid of sections based on State Well Numbers. Well screen information and/or well depth is also often missing, making it difficult to determine which wells might be impacted by changes in shallow groundwater. Well log information is often inaccurate, making it difficult or impossible to match a well log to a well location in order to evaluate lithology and verify well characteristics. In addition, databases and previous records are often lacking an updated well status, meaning a given well may no longer be active or may even have been destroyed and is no longer there. Additional information is needed to verify well locations, identify well type (e.g., agricultural or domestic use), and refine understanding of basin geometry (i.e., depth and geologic layering). A well inventory program has been identified in the Projects and Management Actions section (Section 6.0) to help address this need.

5.3.2 Groundwater Level Data

As discussed above, current groundwater level data are insufficient to reliably characterize certain areas of the USLR Subbasin – primarily in Pala Subbasin, northeast alluvial fan areas of Pauma Subbasin, and southern portion of Pauma Subbasin. These data gaps include tribal areas, areas identified as containing SDACs, potential GDEs, or interconnected surface waters, and domestic well owners. Depending on tribal involvement in the future, additional potential monitoring locations could be added to the monitoring network to provide control in current data gap locations. As data are collected and reviewed, future recommendations may be made to add new monitoring locations or revise the selected monitoring locations. Tribal cooperation and data sharing with regards to tribal wells, tribal surface water diversions, and groundwater levels in the Pala Subbasin will be paramount if the PVGSA is to prevent undesirable results while fully respecting FRWR in the Pala Subbasin.

Within the Pauma Subbasin, a total of 28 wells were monitored for water level during the development of this GSP. The San Luis Rey River flows from the Lake Henshaw basin along the south side of the eastern Palomar Mountain range and then through a fractured crystalline bedrock canyon east of the Pauma Subbasin. It flows into the basin through the Rincon Reservation, entering public lands at the reservation boundary west of the Rincon Ball Fields at roughly latitude 33.273, longitude -116.963. From that point, the first monitoring well location is approximately 2 miles downstream (well MW-6). A monitoring well could be added closer to the reservation boundary to provide a monitoring point near the upstream end of the San Luis Rey River within the Pauma Subbasin depending on the availability of land for a new monitoring well. RMSs for the evaluation of sustainability management criteria may also need to be added to be representative of domestic, SDAC, tribal, and environmental users.

Additional monitoring recommendations are provided in Section 5.5 below to help address some of these data gap areas. The PVGSA is also hopeful that the well inventory program will result in supplemental water level data becoming available through provided records or additional information allowing datasets to be matched to appropriate well locations. Inclusion of a more comprehensive data set for water levels – both spatially and temporally – is critical for understanding general water level conditions throughout the basin (leading to increased reliability of mapped elevations and depth to groundwater), understanding the interaction of groundwater and surface water systems, delineating GDEs, refining sustainability management criteria to ensure they are protective of all groundwater users in the subbasin (including tribal and SDAC areas and shallow domestic wells), and informing management actions.

5.3.3 Groundwater Quality Data

Groundwater quality data is even more limited than groundwater level data. In addition, the same concerns exist regarding the quality of known data, such as well information. 13 of the wells monitored during the development of the GSP were sampled for water quality. Additional water quality monitoring locations are required to understand water quality conditions in the subbasin.

5.3.4 Groundwater Pumping Data

The majority of groundwater pumping records collected for the development of this GSP were from municipal or public water supply entities and agricultural users in Pauma Subbasin. Unrecorded pumping for the rest of the subbasin was estimated based on land use, crop coverages, and previous studies (refer to Section 3.3.5.3.1) in order to assess groundwater budgets and sustainable yield for the subbasin. Refining these estimates of pumping is important for groundwater management going forward. Therefore, the PVGSA intends to initiate a well inventory and metering program (see Section 6.0). Increased knowledge of basin pumping will allow estimates of sustainable yield to be improved and provide additional information for groundwater model refinement to guide the evaluation of potential management activities.

5.3.5 Surface Water Data

Streamflow data is important to evaluate long-term and seasonal changes in surface flow and potential depletions of interconnected surface water and impacts on verified GDEs. Historical streamflow gaging data in the subbasin has been very limited. Several USGS gages have existed in the past, but their records are sporadic and narrow. Furthermore, discussions with USGS personnel indicate that many of the available data have high uncertainty associated with them due to the inability to verify weir or channel geometry. There are no current streamflow gages in the Subbasin. Recommendations for the establishment of streamflow gaging station(s) are provided in Section 5.5 below. At a minimum, monitoring stations could be set up at the upstream end, downstream end, and between the Pala and Pauma Subbasins. The lack of streamflow data combined with limited data providing resolution of groundwater conditions near surface water, contribute to the inability to identify gaining and losing reaches in the subbasin (and therefore determine interconnectivity of surface water with underlying groundwater) and delineate GDEs.

5.4 Evaluation of Sustainability Indicators (§354.34(c))

5.4.1 Chronic Lowering of Groundwater Levels

Groundwater in the USLR Subbasin occurs primarily in alluvium under unconfined conditions. The existing monitoring network provides adequate data to understand the unconfined nature of the basin and to evaluate over time whether changes in groundwater levels are occurring and to what magnitude. On-going groundwater monitoring during implementation of the GSP will be conducted at least semi-annually in the spring and fall to represent high and low groundwater conditions, respectively. In particular, *static* groundwater elevations in spring and fall will be used to evaluate potential exceedance of Minimum Thresholds (MTs) and progress towards Measurable Objectives (MOs) presented in Section 4.0 Sustainable Management Criteria.

5.4.2 Reduction of Groundwater Storage

Because the aquifer in the USLR Subbasin is generally unconfined, and the size and shape of the basin is generally understood, changes in water levels will allow evaluation of changes in groundwater storage in the basin. Overall, declining groundwater levels would suggest a negative change in storage and vice-versa. However, pumping and groundwater level data collected over the first five years of GSP implementation will be used to refine and recalibrate the groundwater model which in turn will be used to reevaluate and plot the annual change in storage.

5.4.3 Degraded Water Quality

Elevated nitrate is known to be detected in some portions of the basin. As previously stated, the existing monitoring network was developed to provide sufficient coverage within the basin (using existing wells), and certain wells were chosen for the monitoring network because they have historic monitoring and/or water quality data that assists in evaluating trends in groundwater conditions over time. Implementation of the GSP will include continued periodic groundwater sampling (semi-annual, as stated above) and collection of data throughout the basin (using the existing network and possibly with additional wells added, see Section 5.5 below) in order to analyze trends in concentrations of constituents of concern, such as nitrate.

5.4.4 Depletions of Interconnected Surface Water

The monitoring network will include collection of surface flow and water level data. At a minimum, such data should be collected at the downstream end of the Pala Subbasin, possibly from an existing gauging station. Streamflow monitoring will facilitate evaluation of seasonal and on-going flow along the San Luis Rey River. The monitoring plan will include evaluation of historic and current river/stream flow as compared with historic and current climatic indicators (temperature and rainfall), and historic (to the degree known) and current fluctuations in groundwater levels in the basin.

5.4.5 Seawater Intrusion

The western end of the Pala Subbasin (western end of this project area) is approximately 17 miles from the nearest approach of the Pacific Ocean coastline near the town of Oceanside. Within the Pala and Pauma Subbasins, based on well information, the alluvium is understood to be up to approximately 600 feet deep in Pauma Valley and 240 feet deep in the Pala Subbasin, overlying crystalline rock of the Southern California Peninsular ranges batholith. Given the relatively shallow depth of alluvium in the basin and distance to the ocean, seawater intrusion is considered to be a highly unlikely undesired result of groundwater extraction in the basin. Therefore, the monitoring program does not include a component to evaluate seawater intrusion. The absence of seawater intrusion will be verified in the five-year report.

5.4.6 Land Subsidence

A relatively shallow alluvial aquifer composed primarily of boulders, cobbles, sand, and silt derived from nearby granitic rock highlands is not expected to undergo subsidence. As with seawater intrusion, the monitoring network will not include components specifically designed to monitor possible land subsidence. However, conditions within the basin will be evaluated, including reviewing DWR-provided InSAR data from the SGMA portal and/or any physical observations that might suggests local subsidence, during the annual and five-year reporting periods. If evidence for subsidence develops during each subsequent five-year reporting period, the development of sustainability goals will be revisited.

5.5 Recommended Changes to the Monitoring Network

Based on the data collected and incorporated into this GSP, and the conditions of the existing monitoring network, the following recommendations are presented.

- Monitoring Well Network
  - New well: As discussed in Section 5.3.2 (above), a monitoring well could be added close to the Rincon Reservation boundary (near coordinates latitude 33.273, longitude -116.963) to provide a monitoring point near the upstream end of the San Luis Rey River within the Pauma Subbasin.
  - Existing well(s)
    - USGS well: There is indication that a USGS well (USGS-331957116584601) may be present along the northeastern boundary of the Pauma Reservation near Pauma Reservation Road. If this well is present and accessible, it may be added to the monitoring network to provide data within the northern portion of the Pauma Subbasin.
    - CASGEM wells: Several wells included in the California Statewide Groundwater Elevation Monitoring (CASGEM) Program are located within the Pala and Pauma Subbasins. Historic data from these wells should be obtained and used in the evaluation of long-term effects of groundwater extraction in the basin, and if accessible, these wells should be evaluated for inclusion in the monitoring network for future monitoring.
  - Network Refinement: During the course of implementation of the GSP, the monitoring network will be re-evaluated and refinements made to improve the effectiveness and efficiency of the well network. This may involve adding wells in areas where additional data is needed, or removing wells from the network where adequate data may be obtained from fewer wells than are currently in the network. In addition, RMSs for the evaluation of sustainability management criteria may also need to be added to be representative of shallow domestic, SDAC, tribal, and environmental users.
- Stream and Surface Flow Gauging: At a minimum, stream and surface flow gauging data should be collected at the downstream end of the Pala Subbasin. There is indication that a stream gauging station already exists in this location. If that station cannot be located and/or accessed, then a stream gauging station should be established and used for future monitoring of streamflow to facilitate evaluation of seasonal and on-going flow along the San Luis Rey River.
- California Irrigation Monitoring Information System (CIMIS) precipitation station: Establishing and utilizing a local CIMIS station would provide more accurate evapotranspiration (ET) estimates and other climatic data for the USLR Subbasin microclimate. This would allow agricultural users in the subbasin to adjust their irrigation system timing – leading to increased efficiency and reduced water demand, as encompassed within the agricultural management plan and best management practices.

- Riparian Habitat: With the potential that riparian habitat exists along the San Luis Rey River within the Pala and/or Pauma Subbasins, the existence of such habitat should be evaluated and, if such habitat is found to exist within the subbasins, monitoring should be conducted to evaluate the condition of such habitat and how that condition informs the sustainability goals and criteria in the GSP.

5.6 Sampling and Analysis Plan (SAP)

The groundwater monitoring program outlined in this SAP presents a standard methodology for the collection of data in sufficient quantities and of adequate quality to enable informed decisions regarding basin conditions. It also outlines all field sampling procedures (groundwater level measurement and water quality sample collection methodology), Quality Assurance and Quality Control (QA/QC), and reporting procedures to be used for the GSP monitoring program. The data collected from that monitoring effort will allow the GSA to demonstrate measured progress toward achieving the sustainability goals set forth in the GSP and inform management decisions.

5.6.1 Monitoring Frequency (§354.38(e))

The scale and frequency of the monitoring effort was considered so that monitoring events would provide a cost-effective means to characterize groundwater conditions (i.e., groundwater elevation and water quality) following implementation of the GSP. Static groundwater levels and water quality will be measured twice per year: once in the spring and once in the fall, to represent seasonal high and seasonal low, respectively. Additional monitoring events may be conducted on an as needed basis to monitor areas of interest, provide adequate detail regarding site-specific surface water and groundwater conditions and to assess the effectiveness of management actions. This includes potential exceedances of MTs, highly variable spatial or temporal conditions, and adverse impacts to beneficial uses/users of groundwater.

5.6.2 Monitoring Protocols (§354.34(i))

Per SGMA, a GSP must contain monitoring protocols that are designed to detect changes in groundwater levels, groundwater quality, inelastic surface subsidence for basins for which subsidence has been identified as a potential problem (not considered a threat in the USLR Groundwater Subbasin), and flow and quality of surface water that directly affect groundwater levels or quality or are caused by groundwater extraction in the basin. Monitoring protocols discussed below have been developed to ensure efficient, accurate, and consistent data collection through the course of the monitoring program.

5.6.2.1 Water Level Monitoring

Attached Table 5-4 lists the group of monitoring wells included in the initial GSP water level monitoring network. Water level monitoring well locations are shown on Figure 5-1. Any updates to the monitoring network (refinement of monitoring location, inclusion of additional monitoring location(s), etc.) will be discussed in the five-year report.

Prior to taking water level measurements, well totalizer readings will be recorded on the field monitoring form, along with noting any nearby pumping wells (i.e., within eyesight, or approximately 100 yards). Groundwater level measurements should be made using an electric water level sounder calibrated to the nearest 0.01 ft. Measurements will be made to the nearest 0.01 ft relative to an established reference point (RP) at the top of each well casing (or sounding tube). Existing survey data for well RP elevation will be available in the monitoring database. If the well does not have an existing reference point elevation, the well will be surveyed and added to the database.

Depths to groundwater will be compared, in the field, to previous measurements and remeasured if significantly different. Groundwater level measurements will be recorded using a permanent ink pen on appropriate field forms. Depth to groundwater measurements will be converted to groundwater elevations (above mean sea level [amsl]) by subtracting the depth to water from the known RP elevation. Whenever possible, water level measurements from all the monitoring wells shall be collected within a 24-hour period. Personal Protective Equipment (PPE) to be worn while performing this task consists of modified nitrile gloves.

Since many of the wells in the monitoring network represent active pumping wells, the sampling team will need to coordinate with well owners prior to a water level monitoring event so that readings may be representative of static water level conditions. If possible, it is recommended that wells be measured after a period of no pumping to allow local water levels to recover (e.g., coordinate well shut off the night before and measure water levels the next morning). The recovery time will vary from well to well and the sampling team will work with the well owner to ensure that water levels used for the evaluation of sustainability criteria represent static conditions.

5.6.2.2 Water Quality Sampling

Attached Table 5-4 lists the group of monitoring wells included in the initial GSP water quality monitoring network. Water quality monitoring well locations are shown on Figure 5-2. Any updates to the monitoring network (refinement of monitoring location, inclusion of additional monitoring location(s), etc.) will be discussed in the five-year report.

The primary goal of groundwater quality sampling is to collect representative water samples to evaluate and track potential groundwater quality degradation. Water quality analysis can be compromised by field personnel in two primary ways: by collecting samples that are not representative of the aquifer to be tested, and by improperly handling the sample after collection. For these reasons, water quality samples should be collected by personnel thoroughly trained in the proper techniques and procedures as detailed below. National guidelines for groundwater sampling are described by the United States Environmental Protection Agency (USEPA) in the *Field Sampling Guidance Document #1220 – Groundwater Well Sampling*. Additionally, procedures, methods and guidelines specific to California standards are described in California Code of Regulations (CCR), Title 22, Social Security, Chapter 15, *Domestic Water Quality and Monitoring*.

Prior to collecting groundwater samples, the following activities should be performed:

- Review of the SAP
- Assembly of proper sampling equipment and forms
- Decontamination of purging and sampling equipment
- Calibration of field instruments following the manufacturer’s instructions

5.6.2.2.1 Decontamination Procedures

Decontamination is a requirement to eliminate the transfer of contaminants from one groundwater monitoring well to another and protect the health and safety of personnel who may come in contact with equipment. All equipment must be decontaminated prior to use and between wells. Decontamination procedures described herein shall be performed at the beginning of each day of field work, between each well, at the end of each day of field work and whenever the equipment is suspected of having been contaminated. A simple triple-rinse system is utilized to decontaminate the water level meter and any other piece of equipment prior to installation into a monitoring well. The triple-rinse system consists of non-phosphate soap solution followed by tap water rinse and final rinse with deionized (DI) water. Submersible pumps, if needed for sampling, are decontaminated by allowing the impellers to run and recirculate while immersed in a non-phosphate solution followed by immersion in a DI or distilled water baths. The final rinse of any equipment entering a monitoring well should be performed with de-ionized or distilled water.

5.6.2.2.2 Well Purging

Properly purging, or removing stagnant water from, a well ensures that the water tested is as closely representative of the in-place groundwater as possible. Because standing water in a monitoring well is typically in contact with the atmosphere, it may not be representative of the surrounding aquifer conditions. Contact with the atmosphere allows influx of atmospheric oxygen, changing the reduction/oxidation (redox) potential of groundwater, and hence, the solubility of certain dissolved species. It should be noted that purging may induce stresses that can bring small particles into suspension and draw them into the monitoring well.

Common purging equipment for groundwater monitoring wells include pumps (peristaltic, positive-displacement, or submersible), bailers, and in-situ devices. All pumping equipment should also be operated at reduced flow rates during purging and sample collection to avoid as much agitation as possible. Since the selected monitoring wells for the basin monitoring during development of the GSP consist of existing, operable wells with dedicated pumps, submersible sampling pumps should not be necessary[19]. In addition, since sampling will be conducted on operating wells, no pump to waste should be necessary.

[19] If, at any time during the initial monitoring period, pumps are removed from selected monitoring wells, a submersible pump should be used to collect necessary water quality samples. The pump should be lowered into the well and suspended immediately above the screen interval of the well using a cable marked and measured so that the pump intake is not lowered past the target depth. It is important that all submersible pumps are equipped with a check-valve between the pumping unit and tubing, to ensure that water cannot flow back into the well at the event of a power outage/surge or pump failure, causing agitation of the source water. Additionally, it is important that all components of the pump that will be in direct contact with the sample water be constructed of inert materials (i.e., stainless steel, or glass), to ensure that truly representative samples are collected. Groundwater in contact with pump components that are not constructed of inert materials may not yield representative water quality results as trace metals can be introduced, thereby changing the physical or chemical properties of the water sampled.

For inactive wells (non-pumping), to ensure that representative groundwater samples are collected, a minimum purge volume of three (3) and up to a maximum of five (5) times the volume of standing water in the well should be removed. For active pumping wells, purging should continue a minimum of 15 minutes to allow consecutive water quality field parameters measurements, as detailed below.

During the purging process, water quality field parameters should be monitored for stabilization, as detailed in the table below.

Table 5-1. Purged Groundwater Stabilization Criteria for Water Quality Indicators

Parameter	Criteria
pH	+/- 0.1
SEC	+/-3 - 5%
ORP	+/- 20 mV
Turbidity	+/- 10% (or <10 NTUs)
DO	+/- 0.2 mg/L

Notes:
- SEC = specific electrical conductance
- ORP = redox potential
- DO = dissolved oxygen
- mV = millivolts
- NTU = nephelometric turbidity units
- mg/L = milligrams per liter

Should water quality parameters not stabilize after the removal of three well volumes, additional well volumes maybe removed. The following table provides the casing volumes of commonly sized monitoring wells.

Table 5-2. Well Casing Diameter vs. Volume

Well Casing Diameter [inches]	Volume [gal/ft]
6	1.469
8	2.611
10	4.286
12	6.122
14	7.996
16	10.444
18	13.218

In order to reduce unnecessary runtime of private or active pumping wells being used for water quality monitoring, it is suggested that water quality sampling be made on a later date than water level monitoring events. The sampling team could therefore coordinate with well owners to sample the monitoring wells while they are being operated and therefore already be sufficiently purged (i.e., have been pumping for a minimum of four hours prior to water quality sampling).

5.6.2.2.3 Monitoring of Field Parameters

During the purging process, a handheld multi-parameter meter should be used to continuously monitor changes in, at a minimum, pH, specific electrical conductance (SEC), turbidity, and temperature. Other commonly monitored water quality constituents include redox potential (ORP) and dissolved oxygen (DO) in the groundwater. There is no set criterion for the number of measurements to be taken to determine stability. Generally, measurements should be taken every 15 minutes during purging, however, measurements must be taken more frequently if the purge volume is low.

For active pumping wells, these field parameters should be measured at the start of purging and approximately every 15 minutes until stable or until approximately five well volumes have been purged. For inactive wells, parameters will be measured at the start of purging, at removal of each well volume up to three volumes, and if not stable at three volumes, then approximately every ½ volume thereafter until stable or until approximately five well volumes have been purged. After the volumetric purging requirement has been met, and all field parameters have stabilized, groundwater samples can be collected.

For active production wells, the sampling team and applicable parties will coordinate and allow for a minimum of four hours pumping prior to collecting samples. Even if a well has been pumping a sufficient period of time, field parameters should still be checked prior to sampling.

If the groundwater monitoring well has a slow recharge rate, then a slower purge rate must be implemented to ensure that three casing volumes have been evacuated. In situations where groundwater monitoring wells are pumped dry (regardless of whether three casing volumes have been removed from that well or not), an adequate purge volume is assumed and, following recovery, groundwater samples can be collected. In these cases, the water chemistry dictates the appropriateness of sample collection. A minimum of four measurements showing consistent parameters from the recovered volume constitutes stability. Once observed and reported to show consistency, the well can be sampled during the next groundwater recharge (US EPA, 2004).

5.6.2.2.4 Sample Collection, Preservation, and Containers

Groundwater samples shall be collected immediately following the purging activities described above. Sampling personnel must wear new nitrile gloves during sampling events and must replace and discard nitrile gloves between purging and sampling of subsequent wells. Samples prepped for analysis should be collected directly from the dedicated sampling port into appropriate laboratory-cleaned containers with Teflon®-free lined caps (when required) and labeled for identification.

The following guidelines should be followed when transferring groundwater from the sampling device into the proper container:

- Sample containers should not be opened until immediately prior to filling.
- The insides of sample containers should not be touched.

- Sampling containers will be filled slowly and with minimal aeration with the pump.
- Sampling containers will not be overfilled, as this can result in the loss of preservative.
- Sampling containers will be filled completely without bubbles or headspace unless specified by the lab.
- Sampling containers will be filled as expeditiously as possible to minimize the time between filling the first sample container and the last.
- Immediately after collection, water quality samples should be placed in a cooler and be maintained at a temperature of 39.2 degrees Fahrenheit (4 degrees Celsius) until they are delivered to the water quality laboratory performing the analysis.

The type of bottles, preservatives, holding times, and filtering requirements depend on the type of laboratory analysis required. Sampling personnel are advised to review the proposed schedule of analysis for each monitoring point with laboratory staff prior to the start of fieldwork, in order to assure that the proper bottles/containers, preservatives, holding time, and filtering procedures are in order.

Groundwater samples will be analyzed for the following general mineral and physical constituents along with selected inorganic parameters:

Table 5-3. Water Quality Sampling Analytical Suites and Approved Methods

Constituent	Method
Physical Properties	
Oxidation-Reduction Potential (Field)	Field Meter - Myron L 6PII
pH (Field)	Field Meter - YSI Pro Plus
Turbidity (Field)	Field Meter - Hach 2100P
Temperature (Field)	Field Meter - YSI Pro Plus
Dissolved Oxygen (Field)	Field Meter - YSI Pro Plus
General Minerals and Inorganic Chemicals	
Alkalinity	SM 2320B
Aluminum by ICP	EPA 200.7
Arsenic by ICPMS	EPA 200.8
Chromium by ICPMS	EPA 200.8
Dissolved Boron by ICP	EPA 200.7
Dissolved Calcium by ICP	EPA 200.7
Dissolved Chloride	EPA 300.0
Dissolved Iron by ICP	EPA 200.7

Constituent	Method
Dissolved Manganese by ICPMS	EPA 200.8
Dissolved Nitrite	EPA 300.0
Dissolved Potassium by ICP	EPA 200.7
Dissolved Sodium by ICP	EPA 200.7
Dissolved Sulfate	EPA 300.0
Hardness Package	Varies
Nitrate + Nitrite Package Calc	Varies
Perchlorate	EPA 314.0
Specific Conductance	SM 2510B
Total dissolved Phosphorous	SM 4500P B E
Total dissolved solids	SM 2540C
Zinc by ICPMS	EPA 200.8

After the two water quality sampling events proposed during GSP development, the suite of analytes will be reviewed to determine if all the analytes are required for future sampling under implementation of the GSP, or if other analytes should be added (e.g., organic compounds). The water quality analytical work will allow on-going evaluation of potential water quality changes occurring in the basin in relation to identified GSP sustainability indicators and objectives.

5.6.2.2.5 Sample Handling and Documentation

Each containerized groundwater sample should be immediately stored in an ice chest or cooler and transported under proper chain-of-custody (COC) protocol to a State-certified laboratory for analysis. Because of their prior experience in the basin, it is proposed that Babcock Laboratories be used for analytical testing. The COC should be filled out completely by the field personnel responsible for sample collection and be maintained up to date throughout the sampling event. The COC should also include water quality field parameters recorded at the time of sample collection. Samples should be submitted to the laboratory well before their holding time is over, and ideally submitted less than 24 hours from the time of collection (i.e., same day, if possible, due to the actual time of day the sample is collected).

5.6.2.2.5.1 Field Documentation

A field data sheet with recorded purging parameters should be completed and stored in a site logbook. Example field forms are provided as Appendix 5a and Appendix 5b for water level and water quality monitoring events, respectively. Additional information to be recorded will include, but not necessarily limited to, the following:

- Date and time of fieldwork

- Monitoring point identification and location
- Summary of daily activities including time of arrivals/departures of Field Technician and/or other visitors to the sampling site(s)
- Weather conditions
- Well totalizer reading
- Note of any nearby wells actively pumping (i.e., within eyesight, or approximately 100 yards)
- Any deviations from the associated work plan or this SAP
- Sample date, time, types, numbers, and quantities
- Sample container preservation steps performed (if required)
- Sampling equipment used
- Decontamination steps performed
- Calibration and maintenance performed
- Multi-meter manufacturer and model number and serial number
- Monitoring point screened interval(s)
- Measured depth to groundwater within well casing(s)
- Calculated casing volume based on depth to the groundwater
- Purge method, device, frequency and discharge rate
- Measured water quality parameters
- Sample collection time, method, and device
- Confirmation that COC forms were properly completed and sample custody transferred in accordance with this SAP

5.6.2.2.5.2 Sample Identification and Labeling

Unique sample numbers must be assigned to identify and describe each groundwater sample collected in the field. Samples should be identified and tracked by sample point number where the sample originated and the date the sample was collected. For example, a sample collected from monitoring well MW-1 on March 4, 2021 at 2:30 pm would be identified as “MW-1-210304-1430.” Trip blanks should be identified using the sample ID assigned by the laboratory. Duplicate samples should be identified in the same way regular samples are identified (i.e., SAMPLE POINT ID-DATE-TIME) but they will be identified as duplicates in the sampler’s notes. Each sample container will be clearly labeled using an indelible permanent ink pen on waterproof adhesive labels.

Each sample container will contain the following information:

- Project name
- Project number
- Site/project location
- Sampling point ID (i.e., MW-1)
- Date and time of collection
- Name of the sampler(s)
- Any preservatives added or present in container
- Analysis to be performed

5.6.2.2.5.3 Chain-of-Custody Procedure

The COC procedure provides a record of the possession and handling of individual samples from the time of collection in the field to receipt by the laboratory for analysis. The field COC record is used to record the custody of all samples collected and maintained by sampling personnel. All sample sets shall be accompanied by a COC. This record documents transfer of custody of samples from the sampling personnel to another person, to the laboratory. The COC also serves as a sample logging mechanism for laboratory personnel. The COC form shall contain the following information:

- Individual sample identification
- Name and signature of sampler(s)
- Project manager and contact information
- Sample collection time(s)
- Sample matrix
- Sample preservative(s)
- Total number of sample containers
- Chain-of-custody record
- Analyses to be performed

5.6.3 Quality Assurance and Quality Control (QA/QC)

QA/QC procedures are important to verify that measured water level and quality data are accurate and representative of actual basin conditions. Therefore, water quality sampling will follow a set of rigorous QA/QC procedures. Many of these procedures are incorporated in the monitoring protocols outlined above to ensure the accurate and reliable collection of water level and water quality data.

In addition, field quality control (QC) samples will be collected and analyzed to assess the consistency and performance of the groundwater sampling activities. QC samples for the sampling program will include field duplicates, equipment blanks, and trip blanks. As part of the water quality analysis, the laboratory will be required to run QA/QC per the method requirements and provide a QA/QC report for each analytical method.

General quality assurance (QA) procedures include documenting field data sheets within site logbooks, and operating instrumentation in accordance with manufacturer instructions, specification, and work plans.

5.6.3.1 Field Duplicates

Field duplicates consist of two samples (an original and a duplicate) of the same matrix that are collected at the same time from the same sampling point. Field duplicate samples are used to evaluate the precision of the overall sample collection and analysis process. Field duplicates shall be collected at a frequency of 1 per 10 regular samples and will be analyzed for the full set of analyses requested for the original sample. Exact locations of duplicate samples and sample identifications shall be recorded in the sampler’s field notes.

5.6.3.2 Equipment Blanks

Collection and analysis of field equipment blanks (EBs) are provided as QC checks of the integrity and effectiveness of field equipment decontamination procedures. Equipment blank samples are prepared by rinsing field sampling equipment, such as a multi-meter, with deionized water and collecting the rinsate in sample bottles. EB samples are assigned unique sample numbers so as to not be identified by the laboratory as EB samples. One EB sample shall be collected for every day of sampling when using non-dedicated equipment to collect groundwater samples. The EB samples will be analyzed for the same compounds as those analyzed for the regular groundwater samples.

5.6.4 General Field Equipment

The following is a list of, at minimum, the general field equipment and supplies used during monitoring and sampling:

- Water level indicator (i.e., electric sounder)
- Log book and field forms
- Calculator
- Water quality bottle sets and COC forms
- Tape measure and engineer's rule
- Basic hand tools, including
  - Screwdriver
  - Pliers
  - Hacksaw
  - Hammer
  - Flashlight
- Adjustable wrench
- Leather work gloves
- Nitrile gloves
- Appropriate personal protective equipment (PPE)
- 5-gallon buckets
- Decontamination supplies, including
  - Tap Water
  - Distilled or deionized water
  - Non-phosphate soap
  - Brushes
- Appropriate monitoring well purge equipment (if necessary), including
  - Submersible pump
  - Generator
  - Hose clamps
  - Safety cable
  - Tubing
  - Bailer

- Filters (as required)

5.6.5 Reporting

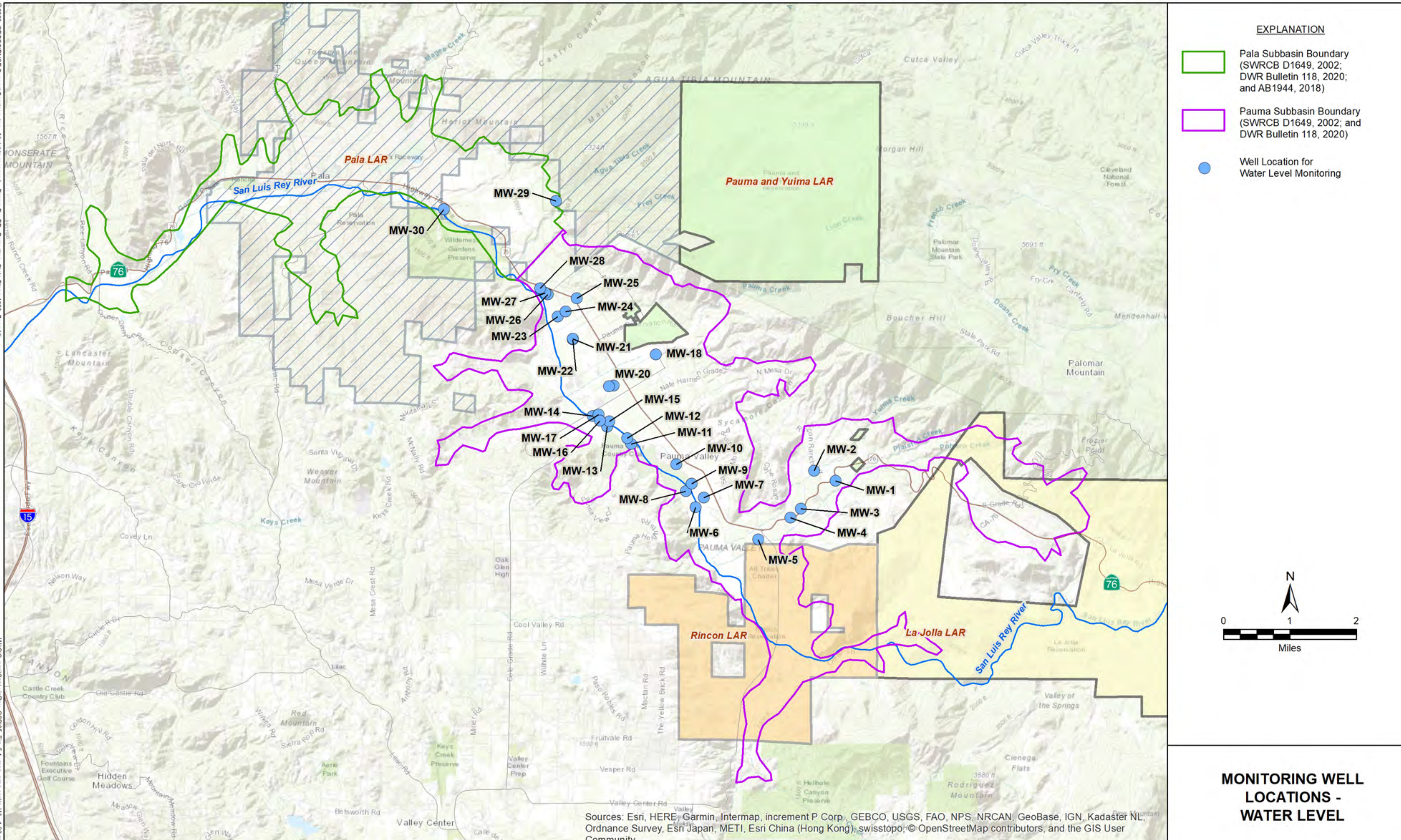
A well inventory database was developed during the GSP development as an Excel spreadsheet. This includes well elevations so that water level measurements can be converted into elevation. New water level monitoring data and groundwater analytical data will be included in the database to create chemographs comparing groundwater quality data to groundwater elevation data over time and to generate quality parameters in the basin. The hydrographs and chemographs will also allow the GSA to track temporal changes in groundwater levels and water quality as new data are collected. Data entered will be compatible with Global Information System (GIS) to generate groundwater elevation and water quality maps of the basin.

Groundwater quality data will be submitted to the GSA approximately 30 days after each sampling event, or at the earliest possible date, depending on normal sample turn-around times and laboratory reporting.

5.7 References (§354.4(b))

California Code of Regulations (CCR), Title 22, Social Security, Chapter 15, Domestic Water Quality and Monitoring. https://www.law.cornell.edu/regulations/california/title-22/division-4/chapter-15

USEPA (United States Environmental Protection Agency), 2004. Groundwater Well Sampling, Field Sampling Guidance Document #1220, Method 314.0.



MONITORING WELL LOCATIONS - WATER LEVEL

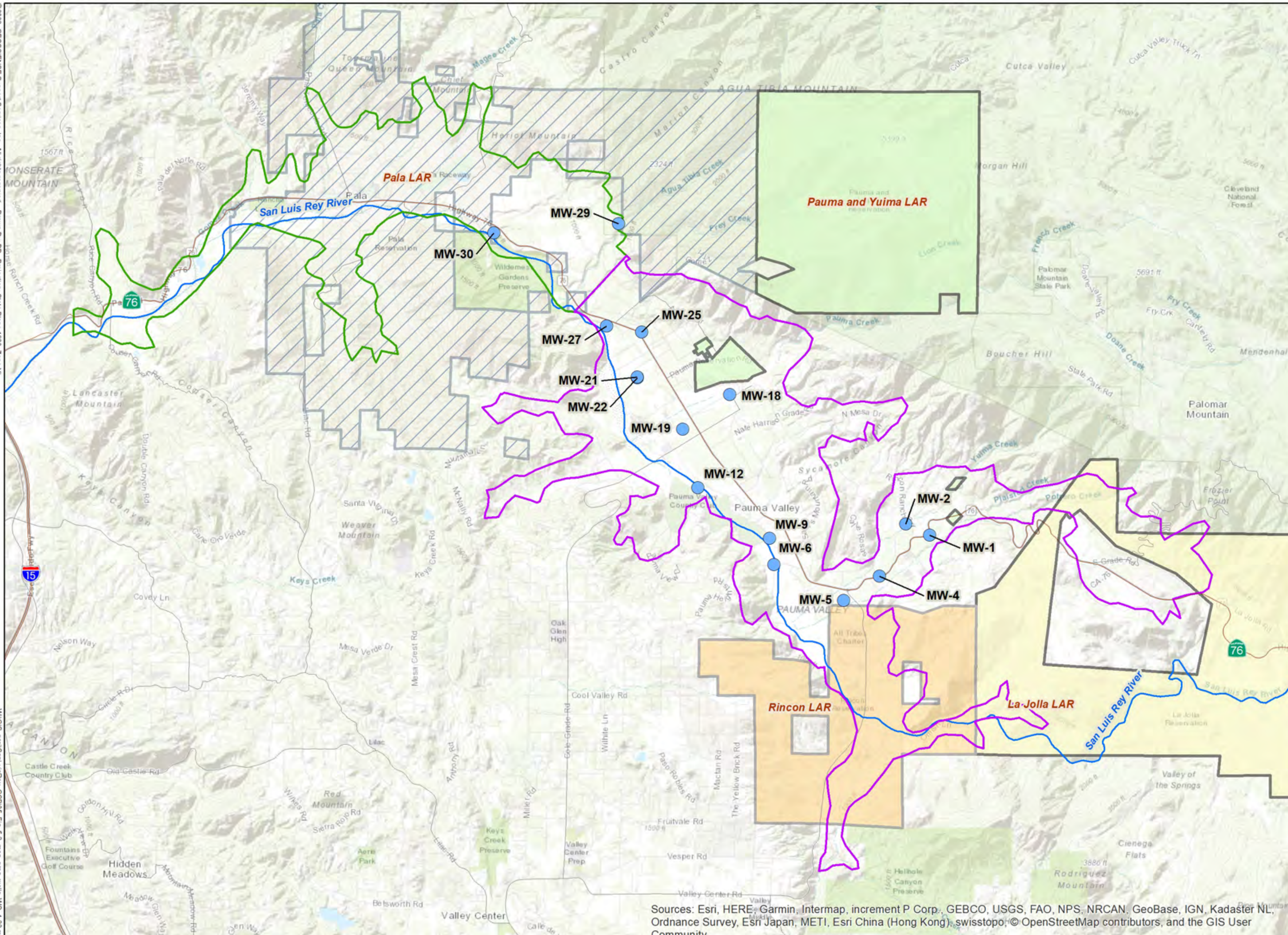
Jan-22

PAUMA VALLEY GSA

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

FIGURE 5-1

GEOSCIENCE



EXPLANATION

- Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)
- Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)
- Well Location for Water Quality Monitoring

N

0 1 2

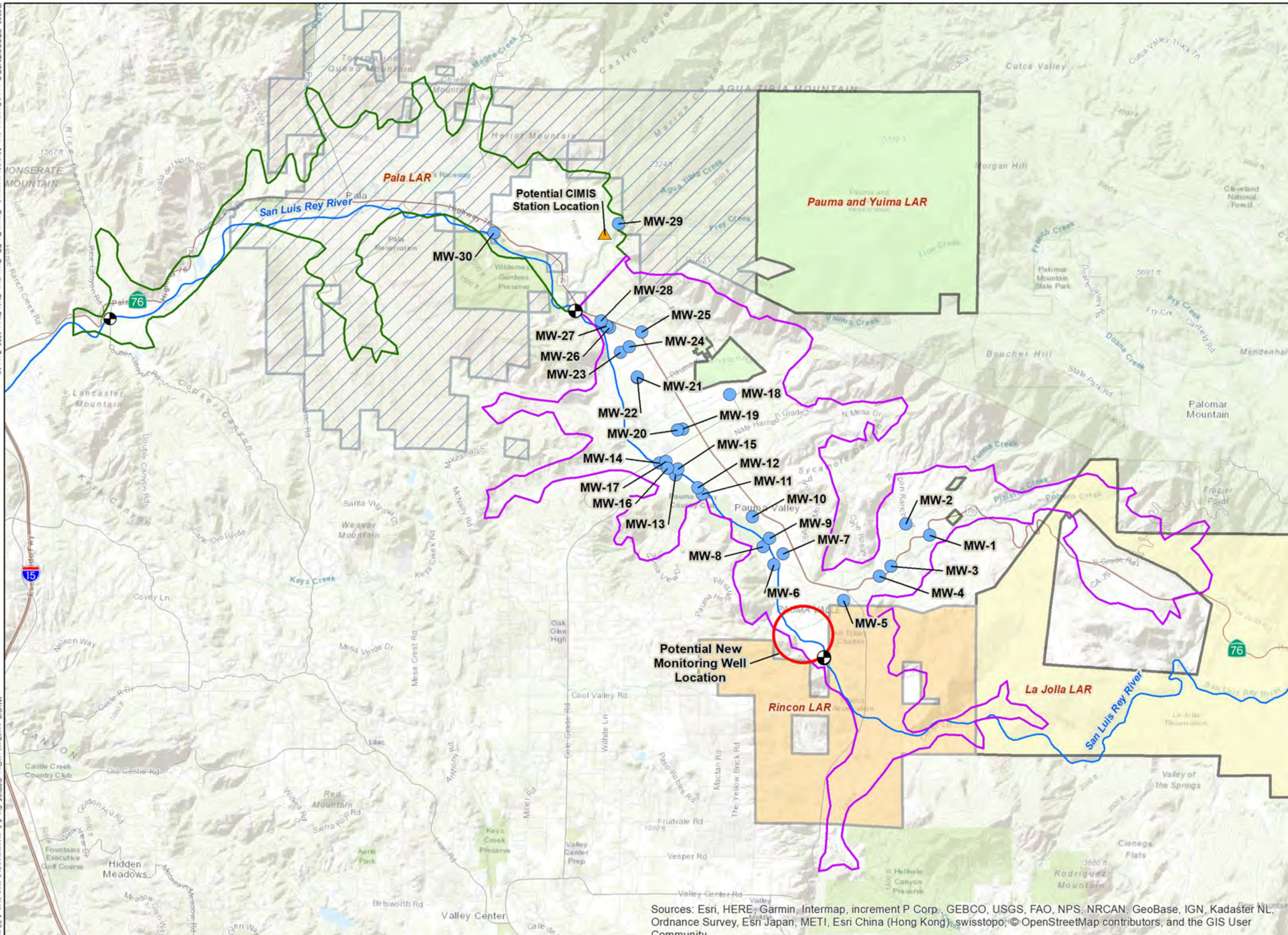
Miles

MONITORING WELL LOCATIONS - WATER QUALITY

Jan-22

FIGURE 5-2

GEOSCIENCE



EXPLANATION

- Pala Subbasin Boundary (SWRCB D1649, 2002; DWR Bulletin 118, 2020; and AB1944, 2018)
- Pauma Subbasin Boundary (SWRCB D1649, 2002; and DWR Bulletin 118, 2020)
- Monitoring Network Well Location
- Proposed Surface Water Monitoring Location
- Potential CIMIS Station Location
- Area for Potential New Monitoring Well Location

N

0 1 2
Miles

RECOMMENDED MONITORING LOCATIONS

Nov-21

PAUMA VALLEY GSA **DRAFT** **FIGURE 5-3**

UPPER SAN LUIS REY VALLEY GROUNDWATER SUSTAINABILITY PLAN

GEOSCIENCE

Monitoring Network Well Information

ID	Elevation	RP Stick Up [ft]	Screen Interval [ft bgs]	Water Quality	Water Level
MW-1	1,588.91	3.15	160-371	x	x
MW-2	1,531.64	1.83	282-582	x	x
MW-3	1,276.59	1.6	TD = 368		x
MW-4	1,199.12	0.52	75-124, 128-284, 284-405?, all perf.	x	x
MW-5	997.61	3.65	150-285	x	x
MW-6	802.56	2.83	120-200	x	x
MW-7	800.40		115-255		x
MW-8	797.25		116-214		x
MW-9	796.52		120-220	x	x
MW-10	805.98		139-224		x
MW-11	765.32		100-200		x
MW-12	759.12	1.9	114-194	x	x
MW-13	748.84		110-210		x
MW-14	743.90		110-200		x
MW-15	754.26				x
MW-16	746.61				x
MW-17	745.86				x
MW-18	952.39		TD = 1,812	x	x
MW-19	808.37		218-318	x	
MW-20	802.25				x
MW-21	738.11		576-1,075 Pump @ 800'	x	x
MW-22	738.20	3.1	Pump @ 275	x	x
MW-23	708.32				x
MW-24	716.73		136-196, 276-356		x
MW-25	757.70		197-397	x	x
MW-26	682.53				x
MW-27	681.03	1.35	100-180	x	x
MW-28	748.82	3.25			x
MW-29	1,247.15	2.05	TD = 220, Pump @ 200	x	x
MW-30	499.34	1.7	TD = 140, Pump @ 120	x	x

6.0 Projects and Management Actions (§354.42; §354.44)

6.1 Introduction (§354.42)

The projects and management actions described in this section provide a framework to achieve the sustainability goal for the USLR Valley Groundwater Subbasin, in accordance with §354.42 and §354.44 of SGMA regulations. Within the USLR GSP, management actions are considered programs or policies that support groundwater sustainability and do not require infrastructure while projects are groundwater sustainability supporting activities that do require infrastructure. Current water use efficiency practices and potential additional management actions and/or projects will be utilized to ensure that the USLR Groundwater Subbasin is operated in such a way to ensure long-term sustainability. Future undesirable results will be mitigated through active monitoring and adaptive basin management. In addition, the implementation of future projects may allow for the increase of sustainable yield in the basin through additional or supplemental recharge.

6.2 Management of Groundwater Extractions and Recharge (Water Balance) (§354.44(a))

A groundwater basin is generally regarded as being in overdraft when pumping exceeds natural and artificial groundwater recharge. Sustainability is considered to be achieved when the seasonal range of groundwater changes, driven by the availability of rainfall and aquifer recharge, remains within the range of elevations that will have no long-term negative impacts on basin pumpers. Under these conditions, sustainable yield is maintained through balanced recharge and groundwater extraction.

As discussed in Section 3.0 Basin Setting, the USLR Groundwater Subbasin is generally operating sustainably under current water demand and water supply conditions. While groundwater levels show a period of decline from the 1990s through the early 2000s, increased imported water usage in conjunction with average to wet hydrological conditions have contributed to the stabilization or increase in groundwater levels within the last five to ten years. However, future unanticipated increases in water demand and/or reduced imported water supplies could result in the subbasin falling out of sustainable management. Projects and management actions that support the efficient use of groundwater resources and increase basin recharge will help the USLR Groundwater Subbasin remain sustainable through normal and drought hydrologic conditions. Key management approaches to avoid undesirable results are discussed in the following sections.

6.2.1 Current Management Actions

6.2.1.1 Agricultural Management Plan and Best Management Practices

In 2016, the San Diego Regional Agricultural Water Management Plan (RAWMP) was prepared by the San Diego County Farm Bureau (SDCFB) and fourteen participating retail water agencies that serve commercial agricultural customers in the northern half of San Diego County, including Yuima Municipal Water District (YMWD) (Weinberg and Jacoby, 2016). The RAWMP describes and documents the San Diego Region's existing and proposed water management programs and activities that affect water use efficiency. As noted in the RAWMP, San Diego County agricultural users are some of the most efficient water users in the state. During development of the GSP, input from representative agricultural users indicated that growers have already enacted water conservation techniques such as using micro sprinklers/drip for irrigation, adjusting watering timing/schedules, regulating irrigation system pressure, and the removal or canopy reduction of low-producing areas.

Typical management practices for agricultural growers in the area include:

- Identify crop type and root zone depths.
- Identify soil and its ability to hold moisture.
- Install moisture sensing devices (i.e., tensiometers) in root zones to monitor moisture levels and use probes or shovels to verify actual moisture content.
- Use micro or drip irrigation and adjust duration of watering so that irrigation does not extend significantly deeper than root zone, except during periods of necessary leaching to remove salts buildup.
- Monitor evapotranspiration (ET) through California Irrigation Management Information System (CIMIS) and periodically adjust watering to meet water needs of crop.
- Continually inspect irrigation system for leaks, etc., and test distribution uniformity at least once a year to ensure proper irrigation coverage.

Additional information on best management practices is available from the University of California Cooperative Extension and University of California Agriculture and Natural Resources (Bender, 2015; Faber, 2015). Agricultural users in the USLR Subbasin plant to continue to implement water use best management practices (BMPs) described above and explore additional water efficiency opportunities, such as investigating the feasibility of installing a local CIMIS station.

6.2.1.2 Drought Response Conservation Program

Currently, efforts to reduce water demand in the subbasin through conservation are increased during times of drought. For example, YMWD institutes a drought response conservation program (Ordinance No. 100-08) to delay or avoid implementing measures such as water rationing or more restrictive water use regulations pursuant to a declared water shortage emergency as authorized by the California Water Code. This plan supports requirements outlined in San Diego County Water Authority's Urban Water Management Plan and Drought Management Plan. Under this program, regulations are implemented in several phases under drought conditions, ranging from voluntary actions (Level 1) to mandatory actions with violations subject to penalty (Level 2 and above). This program, and conservation activities outlined within it, are provided here as Appendix 6a.

Recent water consumption data have indicated that YMWD customers have reduced water usage from 7 to 16% over the last year alone (2021 versus 2020). Water demand reduction and efficient water practices, like the ones enacted through the drought response program, provide opportunities to reduced groundwater pumping and surface water depletions. These reductions support maintaining and possibly raising groundwater levels.

6.2.1.3 Groundwater Level and Water Quality Monitoring

Groundwater level and water quality monitoring programs are essential for effective management of groundwater resources and evaluating sustainability. A clear and continuous understanding of the subbasin groundwater conditions is required for adaptive sustainable management of the subbasin water supply. The collection of water level and water quality data provides important information to evaluate the effects of other projects and management actions, or to determine if additional management actions are necessary to maintain sustainability. On-gong collection of data will also provide a tangible measurement of the benefit of each project or action and ongoing operational effects on groundwater conditions. Since many of the sustainability indicators of the USLR Groundwater Subbasin are measured directly by, or tied to, groundwater elevation data, evaluation of these data will be particularly important. A discussion of the current monitoring network and recommended modifications is provided in Section 5.0 Monitoring Network.

After implementation of the GSP, the GSA will continue monitoring at least twice a year (spring and fall, as described in Section 5.0), but additional monitoring events may take place at the discretion of the GSA. Supplemental groundwater level and water quality monitoring would provide data, as needed, to track conditions in areas of concern, effects of other management actions and/or programs, and allow for effective subbasin management to promote groundwater sustainability. Monitoring results will be presented in the 5-year update report.

Changes to the monitoring network regarding the addition and/or modification of any monitoring location will also be described in the 5-year update report. In particular, the inclusion of monitoring at de minimis domestic users' wells would be beneficial to evaluating undesirable results to domestic beneficial use, as well as helping track sustainable management of the subbasin. At present, no de minimis users have come forward in response to requests for information or following discussion at GSP workshops. Part of the ongoing groundwater level and water quality monitoring action will be for the GSA to take a more proactive approach in engaging de minimis pumpers.

While local districts have generally maintained records within their individual service areas, this unified monitoring effort will provide a holistic view of the subbasin and allow the GSA to identify and adapt to changing conditions before undesirable results are encountered. In addition, it is hoped that future involvement of local tribal entities may allow for even greater understanding of groundwater conditions through the incorporation of additional monitoring locations – to the benefit of all users.

6.2.2 Additional Data Collection (§354.44(c))

Projects and management actions shall be supported by best available information and science. In addition, understanding the amount of groundwater pumping in the basin is a crucial aspect in establishing long-term sustainability. Therefore, the GSA plans to initiate pumping record collection efforts upon implementation of the GSP. This would include registration of each groundwater extraction facility within the management area of the GSA (as allowed under §10725.6), and annual reporting of groundwater extractions (with the exception of de minimis users §10725.8I and §10725.8(e)).

Following implementation of the GSP, the GSA intends to encourage voluntary registration and pumping record collection. However, recognizing the importance of understanding pumping amounts for managing long-term sustainability, a metering program will likely be evaluated. Requiring all groundwater producers to provide pumping records as well as requiring the registration of all groundwater extraction facilities (including non-municipal private wells) would allow the GSA to refine the understanding of basin conditions and assist with the sustainable management of the subbasin.

Currently, as discussed in Section 3.3.5, the characterization of groundwater budgets and determination of sustainable yield relies heavily on the calibrated surface water/groundwater models and assumptions associated with them in place of recorded pumping records. The collection of additional information will lead to greater understanding and allow previous estimates of groundwater extraction to be refined. This in turn will affect the estimate of sustainable yield presented in this GSP. Therefore, sustainable yield estimates may need to be refined during the 5-year reporting periods as pumping data become available.

Updated pumping records could also be used to update and recalibrate the integrated surface water and groundwater model of the subbasin, which can be used to evaluate effects of proposed projects and management actions through feasibility studies. Additional data collection that could be used for model refinement includes conducting aquifer testing in the basin to provide a check on the reasonableness of calibrated aquifer parameters in the model. A refined and recalibrated groundwater flow model would help reduce uncertainty when the GSA performs cost/benefit analyses, and can be used to understand what projects and/or actions are likely to provide satisfactory results, identify areas that may require focused actions to reach and maintain MOs, and project future groundwater conditions with greater certainty.

6.3 Potential Future Management Actions/Projects (§354.44(b))

The GSA intends to take an adaptive management approach in the USLR Groundwater Subbasin. Frequent assessment of progress towards maintaining sustainability would allow the GSA to proactively enact management actions and/or projects as needed to curb any potential issues before they lead to undesirable results. This proactive approach may allow corrections to be made with smaller adjustments instead of requiring larger and potentially costlier projects at a later date. The adaptive management approach would also help basin users achieve and maintain groundwater levels and other sustainability indicators above MOs to ensure drought resilience.

If basin monitoring indicates that additional action is necessary, the GSA will research the feasibility of implementing supplementary management actions and/or projects. Proposed projects will be prioritized by considering potential cost, available funding, and anticipated benefits to groundwater levels, storage, water quality, and/or interconnected surface water. For planning purposes, proposed projects and management actions have been grouped into four tiers, generally corresponding to the order of potential implementation (i.e., projects and management actions in Tier 1 are anticipated to be considered before those in Tier 2, etc.). Potential projects are listed below.

Although not all of the projects and management actions presented here will be needed for the USLR to reach its sustainability goal, each may be considered during GSP implementation. Attached Table 6-1 summarizes how the applicable sustainability indicators for the USLR Groundwater Subbasin will be affected by the proposed projects and management actions. Land subsidence and seawater intrusion are not considered applicable for the Subbasin and are therefore not included in Table 6-1 (refer to Sections 4.3.5 and 4.3.6).

6.3.1 Tier 1 Projects/Management Actions

- **Convening an Interactive Tribal Work Group:** This working group would encourage tribal participation, promote basin balancing maintenance activities, and ensure that federal reserve water rights are protected.
- **Convening a Drought Resilience Work Group:** This working group will help identify avenues to obtain resiliency, minimize impacts of drought conditions on sustainability criteria, and develop long-term plans to facilitate groundwater conservation in the subbasin. The group would review the current understanding of drought in the USLR Groundwater Subbasin, identify any data gaps, and develop a reliable recovery plan.
- **Adaptive groundwater management:** Adaptive management refers to the ongoing review and reaction to groundwater conditions in the subbasin. Frequent evaluation will allow the GSA to react to changing conditions, enact projects and/or management actions as necessary before undesirable results occur, and assess the success or failure of enacted projects and management actions implemented in the USLR Groundwater Subbasin. Annual monitoring and 5-year reporting on the subbasin's progress towards sustainability will provide consistent updates to the GSA, but additional monitoring and evaluation may be pursued as necessary. Investigations into any water quality or unexpected pumping issues would be investigated and addressed promptly by the GSA.
- **Ongoing groundwater level and water quality monitoring:** The collection of water level and water quality data provides important information to evaluate the effects of other projects and management actions, or to determine if additional management actions are necessary to maintain sustainability. On-gong collection of data will also provide a tangible measurement of the benefit of each project or action and ongoing operational effects on groundwater conditions (currently being performed – see Section 6.2.1.2). In addition, data gaps identified in Section 5.0 Monitoring Network will be evaluated and addressed.
- **Agricultural management plan and best management practices:** Establishing best management practices and conservation techniques for efficient agricultural water use, such as using micro sprinklers/drip for irrigation, adjusting watering timing/schedules, regulating irrigation system pressure, and the removal or canopy reduction of low-producing areas (as described in the San Diego Regional Agricultural Water Management Plan (RAWMP) and currently being implemented by many agricultural users in the area – see Section 6.2.1.1). As mentioned in Section 6.2.1, there are already similar existing programs. These can be expanded upon to help further increase efficiency of groundwater usage.
- **Install local CIMIS station:** A local CIMIS station would provide more accurate evapotranspiration (ET) estimates and other climatic data for the USLR Subbasin microclimate. This would allow agricultural users in the subbasin to adjust their irrigation system timing – leading to increased efficiency and reduced water demand, as encompassed within the agricultural management plan and best management practices (above).
- **Water conservation activities:** Water conservation implements policies and programs promoting and incentivizing conservation and the efficient use of water. This includes water used for

municipal as well as agricultural uses. Water demand reduction and efficient water practices reduce stresses on groundwater aquifers as well as on surface water sources, and water conservation actions would assist with achievement of the USLR Groundwater Subbasin sustainability goal. This is especially true for conservation activities geared towards agricultural activities, since agricultural use represents such a large percentage of water use in the basin.

- ***Community outreach:*** Outreach would cover a wide range of actions, including making the public more aware of water use and the importance of conservation, providing water saving tips and recommendations, informing the public of opportunities for conservation savings and/or funding (i.e., rebate programs, grant funding opportunities, etc.), and other opportunities for the public to become involved in basin sustainability efforts.
- ***Irrigation efficiency and best management practices:*** Assessments of irrigation efficiency can be made to identify area of potential water savings, leading to decreased demand.

- **Outreach to San Diego County to layout a framework for GSA collaboration:** GSA collaboration with County procedures involving groundwater management (e.g., developing a well permit notification communication system, updating the San Luis Rey River Watershed Water Quality Improvement Plan (WQIP), etc.) will allow the PVGSA (and potential other San Diego GSAs) to more effectively manage groundwater conditions in the USLR Subbasin.
- **Pumping record collection:** Since understanding the amount of groundwater pumping in the basin is a crucial aspect in establishing long-term sustainability, the GSA plans to initiate pumping record collection efforts upon implementation of the GSP. This would include registration of each groundwater extraction facility within the management area of the GSA and annual reporting of groundwater extractions (with the exception of de minimis users – see Section 6.2.2). Initial efforts are anticipated to be voluntary but may transition to the installation of meters (see below).
- **Well registration and meter installation:** Mandatory metering of all pumping entities and pumping, as allowable under SGMA (excepting de minimis domestic users), would allow the GSA to definitively understand the amount of groundwater pumping occurring in the subbasin, refine estimates of sustainable yield, and assist with sustainable management.

6.3.2 Tier 2 Projects/Management Actions

- **Water conservation activities:**
  - ***Rebate programs:*** Rebate programs typically consist of incentives to encourage water users to upgrade to water saving devices such as high-efficiency toilets, washers, and sprinkler systems, replace plants/yards with high water needs to water wise gardens and landscapes, etc.
  - ***Rainwater capture:*** Rainwater catchment systems can be used to offset irrigation demands, especially in domestic settings.
  - ***Crop swap programs:*** Crop swap programs generally provide financial assistance to agricultural water users for crop conversion projects that save water through replacement of higher water use crops with lower water use varieties.

- ***Low impact development standards for new or retrofitted construction:*** Low impact development refers to systems and practices that use or mimic natural processes to reduce surface runoff and increase infiltration – leading to increased natural recharge.
- ***Leak detection assessment:*** A leak detection assessment traces the flow of water from its source, through a water distribution system, to customers and other uses with the review of records and data collected. Creation of a leak detection program would help ensure supplied water reaches its destination, supporting water conservation in the subbasin.
- ***Voluntary fallowing:*** Where appropriate and based on water supply and associated costs, landowners may choose to fallow land during drought conditions, leading to decreased demand.
- ***Identify new sources of funding for all potential management actions:*** An investigation of available sources of funding (e.g., grants) may facilitate implementation of proposed projects/ management actions and/or provide insight on additional water conservation and management options.

- **Indirect recharge through decreased evapotranspiration:** The Upper San Luis Rey Resource Conservation District (USLRRCD) already has agreements in place to remove Arundo – an invasive, non-native species of reed found in riparian areas – in the subbasin. It is estimated that approximately 40 acres of Arundo are present in Pauma Valley alone. Removal of this vegetation could save upwards of 200 acre-ft/yr of water[20] that would otherwise be consumed by this high water use plant. Additional invasive plant species with high water use requirements (e.g., castor bean, tamarisk, etc.) could also be considered at later phases of this project.

6.3.3 Tier 3 Projects/Management Actions

- **In-lieu groundwater recharge**: In-lieu groundwater recharge refers to the "storing" of local groundwater by utilizing surface water "in-lieu" of groundwater pumping. This is already being implemented to an extent in the USLR Groundwater Subbasin through the supplementation of groundwater pumping with imported water. Through its membership in the San Diego County Water Authority (Water Authority), YMWD has access to 16 cfs of flow through the District's connection to the Water Authority's imported water infrastructure. YMWD then sells Colorado River and State Water Project (SWP) water within the subbasin (see Section 2.1.2.3). At any given time, YMWD can draw up to 16 cubic feet per second (cfs) from the imported water distribution system, depending on the adequacy of supply available to the Water Authority and its member agencies, which corresponds to approximately 11,583 acre-ft/yr. Recent imported water use in the basin over the last 5 years (Fiscal Year 2017 through 2021) is 5,127 acre-ft/yr, which is approximately only 44% of the potential maximum amount. Increasing imported water usage in the basin, as needed, will allow any exceedances to be addressed using an already established

[20] Assumes an ET for "giant reed" of 63.4 inches (Aspen, 2020). Estimate includes consumption of surface water, soil moisture, and groundwater.

infrastructure and water supply system. In-lieu use of other supplemental water supplies (such as surface water from VID/City of Escondido) may also be explored.

- **Outreach to VID/City of Escondido/Rincon to explore potential supplemental water supplies for in-lieu use or managed recharge:** The GSA is interested in exploring the feasibility of obtaining local surface water from VID/City of Escondido/Rincon to supplement water supply in the USLR Subbasin (through either in-lieu use or managed groundwater recharge).
- **Stormwater and/or dry weather capture:** Stormwater and local runoff could be captured using in-channel or off-channel recharge basins to enhance infiltration and increase groundwater recharge in the USLR Groundwater Subbasin.
- **Aquifer Storage and Recovery (ASR)/managed aquifer recharge:** Surplus imported water could be recharged to increase groundwater storage when surplus water is available. This additional storage would help maintain groundwater levels above MOs and provide resiliency during drought periods. The additional recharge would also serve to increase sustainable yield, thereby increasing the volume of groundwater that can be pumped sustainably. Future agreements with VID/City of Escondido/Rincon could be explored for the possibility of allowing increased surface flow in the San Luis Rey River through the USLR Subbasin.

6.3.4 Tier 4 Projects/Management Actions

- **Groundwater pumping curtailment/allocation:** Groundwater pumping curtailment or restrictions halts or lessens the decline of groundwater levels, allowing water levels to recovery and groundwater storage to increase. Although recognized as an effective tool for achieving groundwater sustainability, pumping restrictions represent a last resort effort and would only be considered by the GSA in the event that other projects and management actions are unable to allow the subbasin to be managed within sustainability goals. At this time, the basin is thought to be in general sustainability – as indicated by stable or increasing observed groundwater elevations and balance between estimated groundwater inflow and outflow. Any deficit resulting in declining groundwater levels and storage is expected to be able to be addressed through in-lieu recharge and/or the enactment of one or several management actions and/or programs listed above.

6.4 Project/Management Action Implementation and Schedule

In order to meet MOs or address exceedances of MTs, the GSA intends to implement potential projects and management actions on an as-needed basis. In general, projects and actions will be considered in according to the tiered structure presented in the previous section. If a particular project or management action is selected for implementation, a feasibility study will be conducted to determine associated costs, uncertainty, and potential effects/benefits.

Immediately following GSP submittal and approval, the GSA intends to begin the process of implementing Tier 1 management actions. Priority for the GSA include the outreach activities (to tribal entities, the County, VID/City of Escondido, and the public) as well as additional data collection (water levels, water quality, pumping, evaluating data gaps and monitoring recommendations outlined in Section 5.0, etc.). These collaborative and information gathering efforts are deemed to be of utmost importance for establishing cooperative sustainable management of the basin and refining understanding of groundwater conditions.

In general, tiered projects and management actions are anticipated to be implemented according to the following schedule:

- **Tier 1 Projects and Management Actions:** Begin process of implementing or conducting feasibility study within the first 5 years of GSP adoption.
- **Tier 2 Projects and Management Actions:** Begin process of implementing or conducting feasibility study as needed in response to change in current basin status to avoid potential undesirable results.
- **Tier 3 Projects and Management Actions:** To be implemented only if undesirable results occur and can not be mitigated with other Tier 1 and/or Tier 2 projects and management actions. Undesirable results are indicated when two consecutive exceedances occur in each of two consecutive years, in 25 percent or more of the RMSs (or Key Wells).
- **Tier 4 Projects and Management Actions:** To be implemented as a last resort effort in the event that other projects and management actions are unable to address undesirable results and allow the subbasin to be managed within sustainability goals.

However, while Tier 1 and Tier 2 actions are being pursued, the GSA has the option of bumping up the implementation of additional in-lieu recharge if immediate action is necessary. Based on initial model estimates of future water budgets (Section 3.3.5.7), anticipated operation of the subbasin may result in an average annual groundwater storage decline of 100 acre-ft/yr. This volume of water, along with a margin of safety for any effects of climate change, can be replaced with the in-lieu use of excess imported water available through YMWD's membership with the Water Authority. As mentioned previously (Section 6.3.3), infrastructure and water contracts are already in place to allow supplemental imported water to be purchased and brought into the subbasin to offset groundwater pumping. Therefore, this existing system can be relied upon to address any unanticipated exceedances or undesirable results that might arise during the development of priority Tier 1 and Tier 2 activities. Tier classification of other projects and/or management actions may also be adjusted according to funding opportunities, need, and potential benefit.

6.5 Measurable Objective and Expected Benefits

As noted previously, the increased use of imported water has helped create the stable and recovering groundwater elevations observed within the last five to ten years. Current and ongoing best management practices and conservation activities, as well as the evaluation of and implementation of proposed projects or management actions, will help support the continued operation within the current sustainable yield of the groundwater basin. Anticipated benefits of each proposed project and management action as they relate to measurable objectives are listed in Table 6-1. Additional modeling to assess project-specific impacts is anticipated to accompany feasibility studies for larger projects that require significant changes in basin operation or the development of infrastructure (e.g., stormwater capture, in-lieu recharge, etc.).

6.6 Permitting and Regulatory Process

Permitting and regulatory processes associated with proposed projects will be evaluated and identified during the feasibility study conducted prior to implementation. All applicable groundwater laws and rights will be respected during the development of proposed projects.

6.7 Public Notice and Outreach

Prior to initiating a feasibility study for any of the proposed management actions or projects, the GSA set up a public meeting to present details about the proposed action/project and feasibility study and receive feedback from basin stakeholders. invitations to participate will be extended using the public outreach and professional communication lines and noticing techniques used during development of the GSP. Public notice would also occur in accordance with all pertinent laws and permits. GSA management operations will be documented and discussed in the 5-year update report.

6.8 Legal Authority

SGMA gives the GSA certain authority to implement the GSP to provide local control and flexibility consistent with the sustainability goal (§10725). This includes:

- Adopting rules, regulations, ordinances, and resolutions in compliance with any procedural requirements
- Conducting investigations to determine the need for groundwater management, prepare and adopt a GSP and implementing rules/regulations, propose and update fees, and monitoring compliance and enforcement
- Requiring registration of groundwater extraction facilities and installation of water-measuring devices (except for de minimis extractors)
- Requiring reports of diversion of surface water
- Purchasing and providing water in exchange for a groundwater extractor's agreement to reduce or cease groundwater extractions

6.9 Estimated Costs and Funding Plan

The feasibility study conducted prior to initiating any of the proposed management actions or projects will include a cost estimate and funding plan. This process should include identification of any available funding (i.e., grants) for each proposed project/activity.

6.10 Relationship to Additional GSP Elements

The collection of additional data (included in a couple Tier 1 activities) will allow the GSA to refine estimates of sustainable yield in the basin and better define groundwater conditions. In addition, implementation of certain projects (e.g., in-lieu recharge) may increase sustainable yield in the subbasin through increased or supplemental recharge. Updates to the hydrologic conceptual model and sustainable yield estimates will be discussed in the 5-year report.